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A monthly magazine edited for the pulp, paper, and paperboard manufacturing industry and directed specifically toward management, supervisory, production, and technical personnel. Sent without charge, upon written request, to qualified individuals in the industry in the U.S. and Canada. (A thirteenth issue, a Buyers' Guide, is published in November.)

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Information in this volume is designed to present a comprehensive review of the structure and status of the pulp and paper/board industry of United States and Canada. Every effort has been made to provide accurate data. To the best of the editors' knowledge, data are reliable and complete, but no warranty for this is made.

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NORTH AMERICAN OVERVIEW

North America is the world's most important pulp- and paper-producing region, accounting for about 50% of worldwide pulpmaking capacity and 40% of paper and paperboard capacity.

Paper and paperboard production has just about matched general economic activity during the 1980s. Printing/writing grades have shown strong growth because of the spread of smaller computers and the demand for higher-quality paper in advertising. Packaging grades have shown somewhat slower growth due to inroads by plastics in some market segments. Industry profitability improved strongly during the latter part of the decade, helped by favorable market conditions and the decline of the dollar.

The North American Overview is divided into two sections: United States and Canada. For each country there is a chapter that examines trends in industry structure, production, prices, profitability, capital spending, capacity expansion, mergers and acquisitions, labor, wood supply, energy, transportation, and environmental control and regulations.

FINANCIAL DATA

All sales and income figures are shown in U.S. dollars, unless indicated "C$" for Canadian dollars.

PRODUCTION DATA

All capacity production data are set in short tons of 2,000 lb, unless specifically indicated as metric.

To convert to metric tons: multiply by 0.90718

To convert to short tons: multiply by 1.1023

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UNITED STATES

INDUSTRY STRUCTURE

The U.S. paper industry avoided the well-publicized decline of "Smokestack America" in the 1980s, and it remains a low-cost producer in excellent position to compete at home and in world markets. By closing inefficient facilities, spending intensively to upgrade equipment, and winning concessions from its workforce, the industry weathered two recessions at the beginning of the 1980s and the erosion of its markets when the dollar soared in the the middle years of the decade. Tough measures taken during these down periods have left companies in generally good competitive health and have set the stage for the record surge in earnings that has accompanied the weaker dollar and tighter markets of the past two years.

Paper and allied products ranks eighth among U.S. manufacturing industries in value of shipments, according to 1986 data from the Bureau of the Census. The value of shipments for the industry surged 11.1% in 1986, moving paper up from the ninth to the eighth spot and displacing primary metals, which declined 7.8%. Paper now falls behind food, transportation equipment, machinery, electrical machinery, chemicals, fabricated metal products, and petroleum and coal products among U.S. manufactures.

The industry's shipments of $103.8 billion accounted for 4.6% of total U.S. manufactures in 1986, while its workforce of 674,000 employees accounted for 0.7% of the total U.S. nonagricultural payroll. During the 1980s, employment has ranged from a low of 661,000 in 1982 to a high of 693,000 in 1980. In 1986, paper and allied employment ranked eleventh among U.S. manufacturing industries.

INDUSTRY LEADERS

Ranked by sales, the largest U.S. paper industry company is Georgia-Pacific Corp., with revenues of $8.60 billion in 1987. G-P gets a substantial portion of its sales from solid wood and other forest products, however, and ranks further down the list in pulp and paper capacity. International Paper Co. is second in terms of sales, with revenues of $7.76 billion in 1987. IP leaped to the No. 2 position with the purchase of Hammermill Paper Co. in 1986. Weyerhaueser Co. ranks third with 1987 sales of $6.99 billion. Like G-P, Weyerhaueser does a large amount of business on the forest products side of the industry as well as in pulp and paper.

Fourth on the list is James River Corp., with sales of $5.10 billion in fiscal 1988 (ended April 1988). James River has continued to grow dramatically through acquisitions, most recently of Dunn Paper Co. in 1987 and Crown Zellerbach Corp. in 1986. Tissue and consumer products producer Kimberly-Clark Corp. ranks fifth with 1987 sales of $4.88 billion.

PAPER MACHINES IN OPERATION

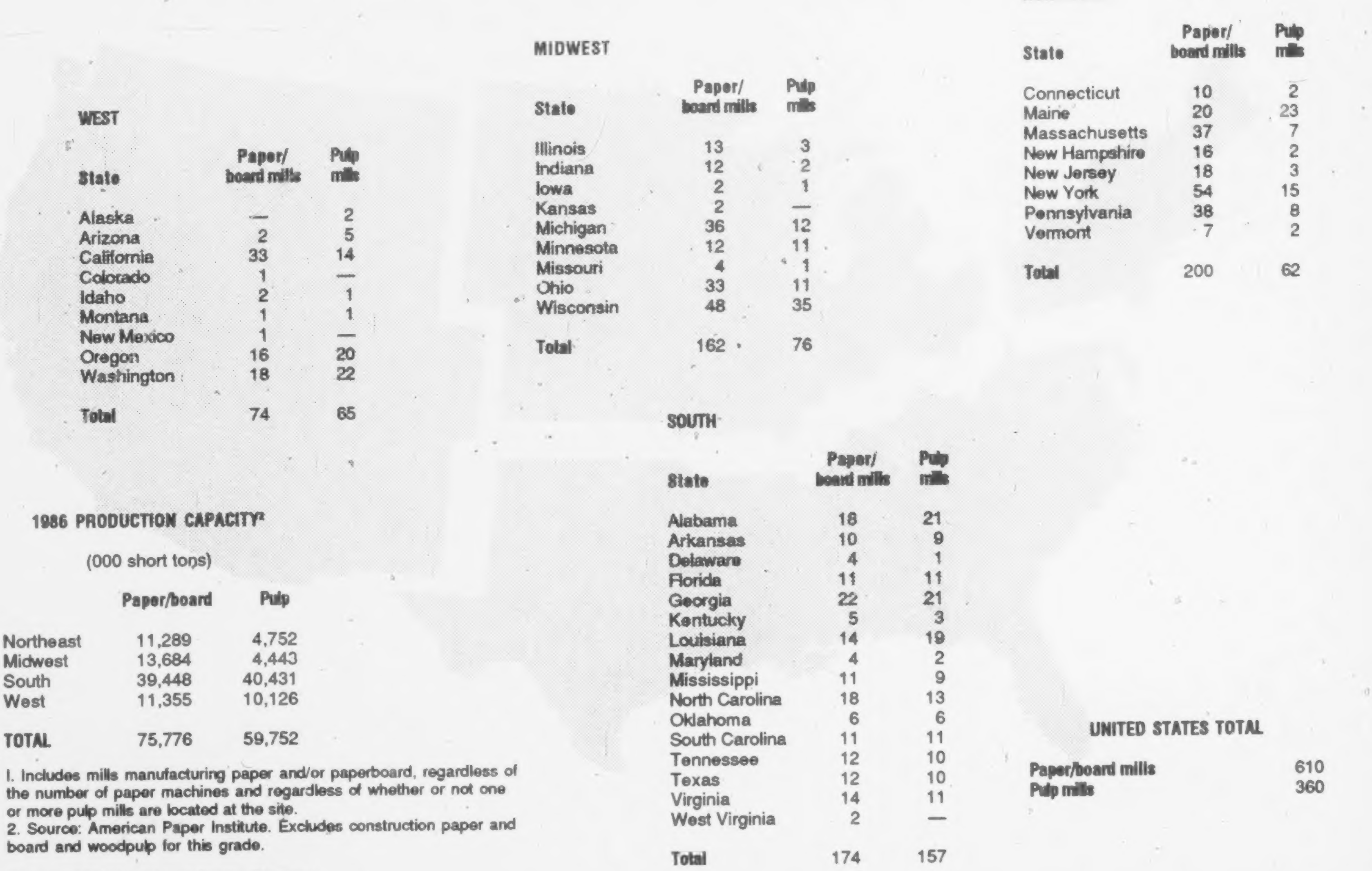
	Number of machines			Machine capacity*
	1986	1980	1975	1986
Newsprint	42	43	38	5,804
Printing/writing	426	452	475	20,980
Packaging	178	205	228	5,758
Tissue	212	236	240	5,472
Total paper	858	919	981	38,014
Unbleached kraft	69	74	69	18,622
Solid bleached	26	30	31	4,576
Semichemical	38	47	51	5,557
Recycled	186	209	244	9,008
Total paperboard	319	360	395	37,763
Total paper & board	1,177	1,279	1,376	75,777

* 000 short tons.

Source: American Paper Institute.

NUMBER OF PULP, PAPER, AND BOARD MILLS IN U.S., BY REGION

(Number of mill sites)[1]



WEST

State	Paper/ board mills	Pulp mills
Alaska	—	2
Arizona	2	5
California	33	14
Colorado	1	—
Idaho	2	1
Montana	1	1
New Mexico	1	—
Oregon	16	20
Washington	18	22
Total	74	65

MIDWEST

State	Paper/ board mills	Pulp mills
Illinois	13	3
Indiana	12	2
Iowa	2	1
Kansas	2	—
Michigan	36	12
Minnesota	12	11
Missouri	4	1
Ohio	33	11
Wisconsin	48	35
Total	162	76

NORTHEAST

State	Paper/ board mills	Pulp mills
Connecticut	10	2
Maine	20	23
Massachusetts	37	7
New Hampshire	16	2
New Jersey	18	3
New York	54	15
Pennsylvania	38	8
Vermont	7	2
Total	200	62

SOUTH

State	Paper/ board mills	Pulp mills
Alabama	18	21
Arkansas	10	9
Delaware	4	1
Florida	11	11
Georgia	22	21
Kentucky	5	3
Louisiana	14	19
Maryland	4	2
Mississippi	11	9
North Carolina	18	13
Oklahoma	6	6
South Carolina	11	11
Tennessee	12	10
Texas	12	10
Virginia	14	11
West Virginia	2	—
Total	174	157

UNITED STATES TOTAL

Paper/board mills	610
Pulp mills	360

1986 PRODUCTION CAPACITY[2]

(000 short tons)

	Paper/board	Pulp
Northeast	11,289	4,752
Midwest	13,684	4,443
South	39,448	40,431
West	11,355	10,126
TOTAL	75,776	59,752

1. Includes mills manufacturing paper and/or paperboard, regardless of the number of paper machines and regardless of whether or not one or more pulp mills are located at the site.
2. Source: American Paper Institute. Excludes construction paper and board and woodpulp for this grade.

Source: *1988 Lockwood-Post's Directory.*

Thirty-two forest products companies made the most recent Fortune 500, a list of the country's 500 largest companies compiled by *Fortune* magazine. Georgia-Pacific ranked 44th, followed by IP at 52nd and Weyerhaeuser at 58th. Georgia Kraft Co., spun off in 1987 in a reorganization by Mead Corp, Scott Paper Co., and Temple-Inland Inc., was No. 474 on the list.

The forest products group did very well in comparison with the rest of the Fortune 500, reflecting the tight markets and high prices enjoyed by the industry in 1987. Forest products posted the biggest increases of any group in 1987 sales and earnings: 17.9% for sales and 59.7% for profits. Median earnings for the 32-member forest products group were $125 million in 1987 on sales of $1.53 billion. The forest products group ranked eighth in return on sales, with profit margins of 6.5% vs 4.6% for the Fortune 500 overall.

Capacity leaders. International Paper remains the capacity leader in the U.S. industry by a wide margin with about 18,900 tpd of pulp and 19,000 tpd of paper and paperboard capacity. IP's paper and paperboard capacity is up about 5,000 tpd since 1983, thanks largely to the

LEADING U.S. FIRMS

(1987 sales of companies with capacities of 1,000 tpd or higher)

Rank	Company	1987 sales	Pulp capacity (rank)	Pulp capacity (tpd)	Paper/board capacity (rank)	Paper/board capacity (tpd)
	$1,000,000,000 or higher					
1	Georgia-Pacific Corp.	8,603,000,000	5	10,648	5	9,589
2	International Paper Co.	7,763,000,000	1	18,885	1	18,980
3	Weyerhaueser Co.	6,989,829,000	2	11,147	8	8,645
4	James River Corp. (fiscal 1988)	5,097,978,000	9	7,145	6	9,374
5	Kimberly-Clark Corp.	4,884,700,000	17	4,013	16	3,700
6	Champion International Corp.	4,614,723,000	6	10,375	3	10,970
7	Mead Corp.	4,208,800,000	15	4,965	14	5,505
8	Scott Paper Co.	4,122,000,000	12	5,483	12	6,560
9	Boise Cascade Corp.	3,820,810,000	7	8,740	9	8,510
10	Stone Container Corp.	3,232,919,000	3	10,810	2	12,003
11	Great Northern Nekoosa Corp.	2,589,000,000	4	10,715	4	9,980
12	Union Camp Corp.	2,307,599,000	8	7,800	10	7,400
13	Louisiana-Pacific Corp.	1,921,600,000	34	1,200	—	—
14	Westvaco Corp.	1,903,606,000	10	6,688	13	6,425
15	Fort Howard Corp.	1,757,728,000	30	1,550	26	2,340
16	Temple-Inland Inc.	1,602,700,000	14	5,025	11	6,795
17	Willamette Industries Inc.	1,431,624,000	22	2,555	17	3,350
18	Sonoco Products Co.	1,312,052,000	47	200	23	2,613
19	Bowater Inc.	1,231,002,000	13	5,374	15	3,865
20	Jefferson Smurfit Corp.	1,099,465,000	11	5,645	7	9,312
21	Federal Paper Board Co. Inc.	1,025,727,000	18	3,900	20	3,067
22	Packaging Corp. of America	1,000,000,000	24	2,210	18	3,190
	$500,000,000—$999,999,999					
23	Potlatch Corp.	992,077,000	25	2,185	25	2,525
24	Pentair Inc.	789,245,000	45	450	30	1,800
25	Appleton Papers Inc.	779,000,000	41	580	43	1,060
26	ITT Rayonier Inc.	757,000,000	20	2,770	—	—
27	Consolidated Papers Inc.	742,835,000	31	1,459	27	2,299
28	Chesapeake Corp.	675,713,000	32	1,400	28	2,050
29	Longview Fibre Co.	569,399,000	19	3,000	22	2,800
	Below $500,000,000					
30	Pope & Talbot Inc.	426,908,000	39	900	51	415
31	P.H. Glatfelter Co.	423,680,000	37	1,055	36	1,450
32	Wausau Paper Mills Co.	251,371,000	46	220	47	740
33	Garden State Paper Co. Inc.	169,989,000	36	1,100	45	955
34	Waldorf Corp.	122,222,000	—	—	42	1,100

continued

Hammermill acquisition in 1986. Weyerhaeuser is second in pulp capacity with 11,100 tpd, about the same as in 1983. Weyco's 8,700 tpd of paper and board capacity has dropped from second place in 1983 to eighth in 1987, however. Stone Container Corp. holds second place in paper and paperboard with daily capacity of 12,000 tons, and it maintains third place in pulp with 10,800 tpd of capacity. Thanks to a bold series of acquisitions in the containerboard sector, Stone has become one of the major success stories of the 1980s, rising to its present position from 10th place in pulp and paper and board capacity in 1983.

Champion International retains its position as third largest in paper and board, with capacity for 11,000 tpd. Champion has increased its capacity about 3,000 tpd since 1983, largely due to its acquisition of St. Regis Corp. in 1984.

Value of shipments. The value of industry shipments has risen steadily since 1985, when the dollar peaked and markets began to tighten. Shipments in 1985 were worth $93.41 billion, down 1.5% from 1984. Shipments bounced back to $103.92 billion in 1986, an increase of 11.2%, and they climbed to $118.86 billion in 1987, a gain of 14.4% over 1986. Shipments in early 1988 were on track to reach $128.61 billion by the end of the year, according to American Paper Institute estimates, an increase of 8.2% from 1987.

For most of the decade, about 42% of the value of industry shipments has come from primary production of pulp, paper, and paperboard, and the remaining 58% has come from converted paper products and paperboard boxes and containers. Reflecting higher prices for many grades, the share of primary production has risen over the past three years, and in 1988 the split between primary and converted products is expected to be about 45%/55%. The biggest gain came in 1987, when the value of primary shipments jumped to $51.52 billion, up 17.0% from 1986 shipments worth $44.03 billion. Primary products will climb another 12.8% in 1988 to $58.12 billion, according to API estimates.

In 1985, the latest year for which breakdowns are available, the value added by manufacturers contributed 43.2% to the value of shipments vs 56.8% for the cost of materials. Value added by manufacturers ranged from a low of 35.1% for pulp producers and 38.9% for paperboard container and box makers to a high of 47.0% for converted paper products.

INDUSTRY CONCENTRATION

Although still fairly fragmented, the long-term trend in the North American paper industry has been toward higher concentration. In the U.S., the top 15 pulp producers held about 70% of total capacity in 1987, up from 56% in 1983.

LEADING U.S. FIRMS (continued)

(1987 sales of companies with capacities of 1,000 tpd or higher)

Rank	Company	1987 sales	Pulp capacity (rank)	Pulp capacity (tpd)	Paper/board capacity (rank)	Paper/board capacity (tpd)
	Sales data not available					
—	Gaylord Container Corp.	n.a.	23	2,330	19	3,120
—	Simpson Paper Co.	n.a.	21	2,695	21	2,930
—	Procter & Gamble Co.	n.a.	16	4,035	24	2,570
—	Manville Forest Products Corp.	n.a.	26	1,970	29	1,985
—	Newark Boxboard Co.	n.a.	—	—	31	1,795
—	Rock-Tenn Co.	n.a.	—	—	32	1,780
—	Caraustar Industries Inc.	n.a.	—	—	33	1,732
—	United States Gypsum Co.	n.a.	—	—	34	1,561
—	Macon Kraft Inc.	n.a.	—	—	35	1,500
—	Green Bay Packaging Inc.	n.a.	38	1,020	37	1,425
—	St. Joe Paper Co.	n.a.	28	1,700	38	1,300
—	Gilman Paper Co.	n.a.	33	1,200	39	1,200
—	Irving Pulp & Paper Ltd.	n.a.	29	1,575	40	1,165
—	Brant-Allen Industries Inc.	n.a.	35	1,165	41	1,147
—	National Gypsum Co.	n.a.	—	—	44	1,027
—	Interstate Resources Inc.	n.a.	43	530	46	790
—	Virginia Fibre Corp.	n.a.	40	730	48	730
—	Gulf States Paper Corp.	n.a.	42	550	49	625
—	Southeast Paper Mfg. Co.	n.a.	44	500	50	560
—	Parsons & Whittemore Inc.	n.a.	27	1,844	—	—

Source: Compiled from data in Company Profiles section.

U.S. PAPER INDUSTRY VALUE OF SHIPMENTS RANKED WITH OTHER MANUFACTURING INDUSTRIES

($ billion)

	1986	1985	% change
Nondurable goods industries[1]	1,071.6	1,092.0	–1.9
Food, kindred products	314.5	301.6	4.3
Tobacco products	18.0	18.5	–2.7
Textile mill products	54.6	53.3	2.4
Paper and allied products	103.8	93.4	11.1
Chemicals and allied products	198.3	197.3	0.5
Petroleum and coal products	129.3	179.1	–27.8
Rubber and plastics products	72.2	71.3	1.3
Durable goods industries[1]	1,201.7	1,187.2	1.2
Stone, clay, and glass products	56.8	55.1	3.1
Primary metals	101.7	110.3	–7.8
Fabricated metal products	136.0	139.6	–2.6
Machinery, exc. electrical	205.8	215.1	–4.3
Electrical machinery	205.6	192.7	6.7
Transportation equipment	314.1	301.4	4.2
Instruments & related products	60.9	61.0	–0.2
Total manufactured goods	2,273.3	2,279.1	–0.3

1. Includes industries not shown.

Source: U.S. Dept. of Commerce.

U.S. MILL SIZE DISTRIBUTION FOR PAPER/BOARD AND WOODPULP

Mill capacity range (000 tpy)	**Paper & paperboard**				**Woodpulp**			
	Number of mills		**Annual capacity (% share)**		**Number of mills**		**Annual capacity (% share)**	
	1986	**1976***	**1986**	**1976***	**1986**	**1976***	**1986**	**1976***
0-25	143	238	2.4%	4.5%	15	32	0.4%	0.9%
26-50	91	133	4.3	7.2	17	40	1.1	2.8
51-75	70	72	5.6	6.6	17	26	1.8	3.1
76-100	42	52	4.9	6.8	12	20	1.8	3.4
101-125	27	32	4.0	5.2	13	15	2.5	3.2
126-150	26	18	4.6	3.7	7	13	1.6	3.2
151-175	14	23	3.1	5.4	13	13	3.6	3.9
176-200	20	17	4.9	4.7	10	9	3.2	3.2
201-250	25	20	7.3	6.5	19	20	7.0	8.2
251-300	16	17	5.7	6.8	13	12	5.9	6.2
301-350	13	19	5.6	8.9	11	13	6.1	7.9
351-400	10	11	4.9	6.1	14	13	8.9	9.4
401-450	17	11	9.5	6.8	10	15	7.2	12.1
451-500	10	6	6.2	4.2	13	8	10.4	7.3
Over 500	31	18	27.0	16.7	35	22	38.5	25.3
Total	555	687	100.0	100.0	219	271	100.0	100.0

* 1976 includes mills and capacity for hardpressed board and supporting pulp facilities.

Source: American Paper Institute.

About 68% of overall capacity was concentrated in the top 15 paper and paperboard producers in 1987, up from 53% in 1983.

Concentration varies considerably from grade segment to grade segment. Coated paper is the most heavily concentrated, with the top five producers controlling 70% of capacity and the top ten controlling 96%. Three other grades have concentrations of 90% or more among their top ten companies: coated groundwood (90% for top ten, 60% for top five); tissue (93% for top ten, 72% for top five); and bleached paperboard (93% for top ten, 70% for top five).

At the other end of the scale, chemical paper-grade market pulp is the least concentrated, with the top five companies controlling 28% of capacity and the top ten controlling 46%. Other fragmented grade segments are newsprint (62% for top ten, 39% for top five), and recycled paperboard (57% for top ten, 38% for top five).

Mergers and acquisitions. Mergers and acquisitions are the most obvious force behind the acceleration of industry concentration in the 1980s. The companies that *do not* appear in the table of leading U.S. firms illustrate the importance of mergers for companies' fortunes in the 1980s. Nine firms dropped off the list of top companies between 1983 and 1987, all but one of them due to mergers. The exception to the rule, Jacksonville Kraft Co., went bankrupt but was later purchased by a Stone Container-led investor group and reopened. The other eight were Container Corp. of America, Continental Forest Industries, Crown Zellerbach, Hammermill, Owens-Illinois, Publishers Paper Co., St. Regis, and Southwest Forest Industries.

The main beneficiaries of all the buyout activity—those who were most aggressive—were Stone Container, Jefferson Smurfit, and James River. Other companies adding substantially to capacity through acquisitions were Champion International, International Paper, Great Northern Nekoosa, Georgia-Pacific, and Federal Paper Board.

Economies of scale. Also important in the long-term trend toward concentration is the growing size of mills and machines, which limits the ability of smaller operations to compete. Rising energy, fiber, and environmental-compliance costs have also hurt smaller, nonintegrated producers. The result has been a steady stream of bankruptcies and shutdowns of older, inefficient facilities, particularly during lulls in the business cycle.

API data on the size distribution of machines in various grades show that many small machines still exist in the uncoated free-sheet, tissue, packaging papers, and recycled paperboard segments of the industry. Although many of these small machines profitably serve special market niches, some will be vulnerable to efficient new machines being installed in the higher-volume, commodity segments of these markets.

U.S. CAPACITY INTEGRATED TO WOODPULP

(000 short tons)

	1986		1980		1976	
	Tons	**%**	**Tons**	**%**	**Tons**	**%**
PAPER						
Newsprint	5,294	91.3%	4,836	100.0%	3,589	89.4%
Uncoated groundwood	1,387	80.7	1,462	90.0	1,093	83.5
Coated groundwood	3,665	96.2	2,649	95.9	2,218	96.5
Coated free-sheet	2,080	74.0	1,774	79.8	1,359	71.4
Uncoated free-sheet/ cotton fiber	8,008	75.9	6,910	78.7	4,837	64.8
Thin	84	25.0	103	27.0	57	15.9
Bristols	962	91.3	874	85.4	1,092	93.7
Packaging/ ind. converting	4,572	75.6	4,878	80.3	5,071	81.8
Tissue	2,169	40.6	2,575	52.0	2,043	45.4
Total	28,221	75.2	26,061	79.8	21,359	73.1
PAPERBOARD						
Unbleached kraft	18,144	100.0	15,967	100.0	14,568	100.0
Solid bleached	4,368	100.0	4,180	100.0	3,998	100.0
Semichemical	5,411	98.1	4,946	100.0	4,758	100.0
Recycled	323	3.1	434	5.0	513	5.8
Total	28,246	76.6	25,527	75.7	23,837	74.3
Total paper and board	56,467	75.9	51,588	77.7	45,196	73.7

Source: American Paper Institute.

PRODUCTION, EXPORTS, AND IMPORTS

Through the first quarter of 1988, U.S. paper and paperboard production was on the way to its third record-breaking year in a row. Preliminary data from the American Paper Institute showed production of paper and paperboard up 5.3% in the first quarter of 1988 from a year earlier. The seasonally adjusted rate of production was 76.8 million tpy, enough to push the pace of 1988 production above the record 74.5 million tons produced in 1987.

Fears of an economic slowdown or downturn in the months following the October 1987 stock market crash never panned out, and analysts were scrambling in early 1988 to revise their growth forecasts upward. Far from slowing down, the economy grew at a strong 3.9% annual rate in the first quarter, with good prospects for continued growth through the end of the year. Since growth in paper and paperboard production is expected to track real GNP and capacity is expected to grow only 2.3%, operating rates could stay in the mid-90% range if the economy continues strong.

Production levels soared for most grades of paper and paperboard in the first quarter of 1988. Printing and writing papers led the paper grades, with production up almost 10% from a year earlier. Major increases in demand from magazine and other publishers helped push coated paper shipments up 15% from the first quarter of 1987. Continued strong commercial printing activity gave a boost to coated papers as well as uncoated free-sheet. Newsprint consumption by U.S. publishers rose 4.5% in the first quarter, pushing production levels at U.S. mills up almost 7%.

Unbleached kraft paperboard production led the paperboard grades in the first quarter, rising 8.4% from first-quarter 1987. Producers benefited from the weak U.S. dollar in stronger exports of board and also in a resurgence in U.S. manufacturing export activity. Total paperboard production for export was up over 15% in the first quarter, including a 21% increase in kraft linerboard produced for export. Containerboard production for domestic use rose 6.3%, reflecting record demand for fiber boxes.

Market pulp production in the first quarter was running 9.8% above year-earlier levels, according to seasonally adjusted data from API, with chemical paper grade market pulp up 11.3%. Continued strong demand from papermakers and the lure of record pulp prices were expected to keep operating rates hovering around the 100% mark.

HISTORICAL PRODUCTION TRENDS

Paper and paperboard production tends to follow the ups and downs of the general economy, and, except for 1985, that pattern has held true during the 1980s. Following a period of relatively steady growth after the recession of 1974-75, production peaked at 61.3 million tons in 1979 before dropping off slightly in the 1980 recession year. Production recovered somewhat in 1981, rising 1.8%, but another recession began late in the year. This down cycle turned out to be the worst in postwar history for the economy as a whole, although the 1974-75 recession was harder on paper industry production. Slumping along with the rest of the economy, paper and board production fell 4.5% in 1982 to 59.5 million tons, its lowest level since 1978.

As sharp as the 1981-82 downturn was, however, the subsequent upturn was even sharper. After falling 2.6% in 1982, real GNP rebounded by 3.6% in 1983 and then shot up 6.8% in 1984. Following the economy's lead, paper and paperboard production jumped to a record 65.0 million tons in 1983, up 9.3% compared with depressed year-earlier levels and up 4.4% from the previous high of 62.3 million tons produced in 1981. Production climbed an additional 5.8% in 1984 and reached a new high of 68.8 million tons, despite some weakening in the final quarter.

Slower growth and the strong dollar choked off the industry's recovery in 1985, as production fell 2.0% to 67.0 million tons. A sluggish economy depressed domestic demand for such important grades as kraft linerboard, where production plummeted 5.3%, and the strong dollar did double damage by making offshore paper cheap for U.S. consumers and U.S. exports expensive in overseas markets.

After a "Group of Five" meeting in the third quarter of 1985, the dollar began its long drop against many world currencies, a trend that has continued through 1987. Domestic demand also began to pick up during this period, and the result was a dramatic rebound for paper and paperboard production in 1986 to a record 70.9 million tons, up 5.6% from the previous year.

Consumer spending was a big factor in the 1986 upswing. Corrugated box shipments increased by 6% and folding cartons by 4%, reflecting strong gains in market segments such as appliance and television production. Printing/writing paper shipments posted a 6.5% gain, fueled by increased demand for office paper as well as higher printing activity.

The weaker dollar and continued moderate growth in the economy produced a banner year for the industry in 1987. Paper and paperboard production set another record, rising 5.0% to 74.5 million tons. Paperboard production achieved an all-time high, led by a 7.4% increase in unbleached kraft linerboard production. New production records were also set in solid bleached board and recycled board.

Demand for white papers grew as offices increased their use of copy paper, computer printout, and envelopes, and strength in direct mail boosted printing paper demand. Coated paper shipments climbed 9.7% for the year, while uncoated free-sheet posted a 5.5% increase. Newsprint production rose 3.8% to a record 5.8 million tons, as U.S. consumers increased consumption for the fifth year in a row.

EXCHANGE-RATE ROLLER COASTER

Faced with competitive world markets, U.S. exports tend to fluctuate with exchange rates. In 1980, the dollar reached its weakest point in a multi-year slide relative to other major currencies, and U.S. paper industry exports (including pulp, wastepaper, and converted products) posted a 31.9% increase in volume to a record 11.8 million tons. In 1981, the dollar

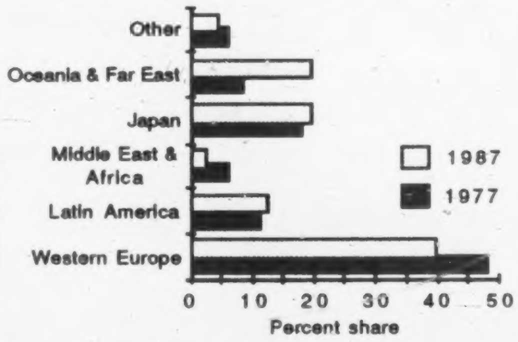
U.S. PAPER & BOARD PRODUCTION BY MAJOR GRADE, 1983-87

	(000 short tons)					(Percent change)			
	1987	1986	1985	1984	1983	1987/86	1986/85	1985/84	1984/83
PAPER									
Newsprint	5,842	5,630	5,428	5,539	5,167	3.7%	3.7%	–2.0%	7.2%
Printing/writing	20,750	19,625	18,423	18,397	17,370	5.7	6.5	0.1	5.9
Uncoated groundwood (s)	1,491	1,540	1,521	1,565	1,531	–3.2	1.2	–2.8	2.2
Coated paper (s)	6,869	6,263	5,875	6,249	5,716	9.7	6.6	–6.0	9.3
Uncoated free-sheet (s)	10,983	10,410	9,690	9,207	8,780	5.5	7.4	5.2	4.9
Thin paper	251	271	262	267	280	–7.4	3.4	–1.9	–4.6
Cotton fiber (s)	161	152	144	147	133	5.9	5.6	–2.0	10.5
Bleached bristol (s)	995	990	930	961	931	0.5	6.5	–3.2	3.2
Tissue paper	5,300	5,095	4,941	4,921	4,789	4.0	3.1	0.4	2.8
Packaging & industrial converting (s)	5,068	5,117	5,204	5,555	5,497	–1.0	–1.7	–6.3	1.1
Unbleached kraft paper (s)	3,075	3,303	3,403	3,666	3,666	–6.9	–2.9	–7.2	0.0
Other paper	1,993	1,814	1,801	1,889	1,832	9.9	0.7	–4.7	3.1
Total paper	36,959	35,466	33,996	34,411	32,823	4.2	4.3	–1.2	4.8
PAPERBOARD									
Unbleached kraft linerboard	17,608	16,402	15,183	16,037	15,001	7.4	8.0	–5.3	6.9
Other unbl. kraft paperboard	1,281	1,287	1,184	1,149	1,121	–0.5	8.7	3.0	2.5
Semichemical paperboard	5,606	5,376	5,088	5,169	4,731	4.3	5.7	–1.6	9.3
Solid bleached	4,406	4,271	3,948	4,048	3,926	3.2	8.2	–2.5	3.1
Recycled	8,594	8,083	7,630	7,637	7,398	6.3	5.9	–0.1	3.2
Total paperboard	37,493	35,419	33,034	34,039	32,177	5.9	7.2	–3.0	5.8
Total paper and board	74,453	70,885	67,030	68,450	65,000	5.0	5.8	–2.1	5.3
CONSTRUCTION & WET MACHINE	n.a.	1,800	1,800	1,800	1,800	n.a.	—	—	—
Total paper and board	n.a.	72,685	68,830	70,250	66,800	n.a.	5.6	–2.0	5.2

(s) = Shipments.
Note: Data may not add to totals because of rounding.

Source: American Paper Institute.

WOODPULP EXPORTS BY DESTINATION



Source: American Paper Institute

strengthened and recession began to affect major overseas markets, causing industry exports to fall 9.9%, although the value of shipments rose a modest 1.4%. In the 1982 recession year, exports fell an additional 7.4%, while the value of shipments plummeted 11.9% due to lower prices and the ever-stronger dollar.

With both prices and demand up in 1983, exports rose 10.3% over a year earlier, but the value of shipments actually declined by 2.2% because of the strong dollar.

In 1984, the dollar set records against major currencies, undercutting U.S. exports in the important market pulp and linerboard sectors despite strong demand in overseas markets. Overall industry exports rose 14.7% to 12.3 million tons, however, on the strength of a 70.4% increase in wastepaper. The value of shipments for paper, board, and products rose 7.2%. Paperboard exports declined 6.7% in 1984, following a 13.4% increase in 1983, while pulp exports were off 1.4%. In 1985, both the strong dollar and

U.S. WOODPULP PRODUCTION BY MAJOR GRADES, 1981-87

(000 short tons)

	1987	1986	1985	1984	1983	1982	1981
WOODPULP							
Bleached sulfite	1,269	1,275	1,364	1,359	1,306	1,242	1,403
Unbleached sulfite	171	164	196	259	310	345	399
Total sulfite	1,440	1,439	1,560	1,618	1,616	1,587	1,802
Bleached & semibl. sulfate	25,404	24,158	22,626	22,350	21,107	19,721	20,070
Unbleached sulfate	21,466	20,484	19,510	20,721	19,590	18,170	19,574
Total white pulp (bleached sulfite + bleached & semibl. sulfate)	26,673	25,433	23,990	23,709	22,413	20,963	21,473
Total chemical paper-grade (total sulfite + bl. & semibl. sulfate + unbl. sulfate)	48,310	46,081	43,696	44,689	42,313	39,478	41,446
Semichemical	4,246	4,191	4,026	4,069	3,812	3,700	3,924
Mechanical	5,714	5,487	5,251	5,506	5,067	5,064	5,319
Total paper-grade	58,270	55,759	52,973	54,264	51,192	48,242	50,689
Dissolving, special alpha	1,312	1,258	1,174	1,206	1,261	1,092	1,353
Total woodpulp	59,582	57,017	54,147	55,470	52,453	49,334	52,042
MARKET PULP							
Chemical paper-grade	6,806	6,264	5,613	5,680	5,255	4,643	4,852
Groundwood, other	14	16	15	15	12	1	0
Dissolving	1,308	1,234	1,172	1,204	1,260	1,089	1,350
Total market pulp	8,128	7,514	6,800	6,899	6,527	5,733	6,202
OPERATING RATES							
Total white pulp	99.9%	97.5%	95.6%	99.6%	98.8%	94.7%	98.6%
Total paper-grade	95.8	93.3	88.9	92.0	88.9	83.7	89.2
Dissolving/special alpha	94.9	89.9	80.7	81.1	82.7	68.0	84.7

Source: American Paper Institute.

weakness in world markets sent exports down 3.4% for the year, while the value of shipments plummeted 10.7%.

The dollar peaked against major world currencies in 1985, and since then it has fallen about 40% from those heights. This ongoing slide in the U.S. dollar has reversed the competitive position of U.S. suppliers and caused a tremendous improvement in U.S. exports.

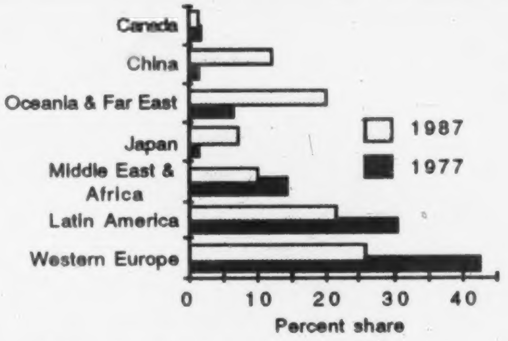
In 1986, U.S. producers were well positioned to take advantage of renewed demand overseas. Overall industry exports rose to 12.9 million tons for the year, a 9.1% gain over 1985, while the value of shipments climbed 16.2%. Paperboard exports, mainly consisting of kraft linerboard, rose 21.8% for the year. Pulp shipments rose 17.5% while wastepaper declined 7.9%.

U.S. exporters continued to benefit from the weak dollar in 1987, as overall exports rose another 12.1% to 14.5 million tons. Thanks to record prices, the value of shipments posted a big 27.8% gain over 1986. Among the important export segments, wastepaper was strongest, rising 18.0%. Pulp exports were up 9.7% compared with 1986, followed by paperboard with a 6.7% increase.

First-quarter 1988 paper and paperboard exports were up 19% from the same quarter of 1987, according to API. Paper exports climbed 20%, topping the one-million-ton mark for the first time since 1981. Paperboard exports hit a new high with an annual rate above 4 million tons, up 18% from the 1987 first quarter. Woodpulp exports climbed 15.3% in the first quarter from a year earlier, and the annual rate of 5.3 million tons was 300,000 tons higher than the import rate—the U.S.'s first postitive trade balance for pulp.

Imports have not responded in the same way as exports to exchange rate fluctuations. Imports rose dramatically as the dollar strengthened in the 1983-85 period, but they continued to rise as the dollar weakened between 1985 and the present. The size of our trade relationship with Canada is one reason for imports' seeming lack of response to exchange rate fluctuations, since the Canadian dollar has

KRAFT LINER EXPORTS BY DESTINATION



Source: American Paper Institute

OPERATING RATES FOR MAJOR GRADE SEGMENTS

[production or shipments (s)/annual capacity]

	1987	1986	1985	1984	1983
PAPER					
Newsprint	98.3	97.0	93.8	94.7	89.5
Printing/writing (s)	93.6	93.5	90.0	92.5	93.2
Tissue	94.1	93.1	92.4	93.3	92.3
Packaging/industrial converting (s)	90.6	88.9	87.0	91.2	90.4
Total paper	94.0	93.3	90.5	92.7	92.0
PAPERBOARD					
Unbleached kraft	98.8	94.8	90.2	96.4	92.1
Semichemical	99.4	96.7	94.0	98.4	92.4
Solid bleached	94.2	93.3	90.3	96.7	95.1
Recycled	92.9	89.7	86.8	87.6	85.1
Total paperboard	96.9	93.8	90.0	94.6	90.8
TOTAL PAPER/PAPERBOARD	95.4	93.5	90.2	93.6	91.4

Source: American Paper Institute.

been even weaker than the U.S. dollar. Another factor is the size and attractiveness of the U.S. market. European suppliers who gained a foothold in the U.S. while exchange rates were favorable have been slow to give up their shipments now that the dollar has turned against them.

Canada will account for 75% to 80% of foreign shipments to the U.S. in 1988, with pulp and newsprint being the dominant grades. In 1987, imports from Canada were up 7%. Canada is the dominant source of U.S. newsprint supplies, although its share has dropped over the long term from 80% in 1950 to 63% in 1970 to about 57% at present. Canada is also the largest foreign supplier of U.S. woodpulp, with a 7% share. Canada and the U.S., the two largest trading partners in the world, have tentatively agreed on the terms of a bi-national trade agreement that would eliminate tariffs for numerous paper and paperboard grades by 1993. If ratified, tariffs on these designated products would be cut in five equal annual stages, starting Jan. 1, 1989.

Import trends in the 1980s. While depressing

HISTORICAL U.S. PAPER AND BOARD PRODUCTION, CAPACITY, AND OPERATING RATES, 1960-87

(000 short tons)

	Production				Capacity		Operating rate
	Paper	Paper-board	Total paper/ board[1]	% change	Total paper/ board[1]	% change	Total paper/ board
1987	36,959	37,493	74,453	5.0%	78,021	3.0%	95.4%
1986	35,466	35,419	70,885	5.8	75,777	2.0	93.5
1985	33,996	33,034	67,030	–2.1	74,301	1.6	90.2
1984	34,428	34,039	68,468	5.4	73,098	2.8	93.7
1983	32,788	32,176	64,964	9.6	71,126	1.5	91.3
1982	30,235	29,065	59,300	–4.5	70,086	2.8	84.6
1981	30,877	31,232	62,109	1.9	68,172	2.7	91.1
1980	30,026	30,952	60,979	–0.3	66,368	2.7	91.9
1979	29,890	31,429	61,319	4.4	64,615	2.4	94.9
1978	28,458	30,275	58,733	3.4	63,091	1.8	93.1
1977	27,870	28,953	56,823	3.2	62,004	1.1	91.6
1976	26,608	28,440	55,048	14.3	61,307	1.9	89.8
1975	23,391	24,756	48,147	–13.9	60,140	1.0	80.1
1974	27,011	28,915	55,926	–0.8	59,527	2.3	94.0
1973	26,811	29,571	56,382	4.6	58,164	4.1	96.9
1972	25,383	28,502	53,885	8.2	55,873	3.2	96.4
1971	23,745	26,037	49,782	2.1	54,136	1.6	92.0
1970	23,375	25,383	48,758	–2.2	53,260	0.3	91.5
1969	23,477	26,376	49,853	5.8	53,094	3.8	93.9
1968	22,206	24,904	47,110	7.7	51,147	4.7	92.1
1967	20,926	22,819	43,745	–0.4	48,850	4.8	89.5
1966	20,725	23,179	43,904	8.4	46,608	7.1	94.2
1965	19,157	21,332	40,489	6.4	43,535	4.6	93.0
1964	18,112	19,954	38,066	6.0	41,623	3.7	91.5
1963	17,320	18,594	35,914	4.4	40,143	3.4	89.5
1962	16,560	17,847	34,407	5.7	38,810	1.3	88.7
1961	15,821	16,727	32,548	4.3	38,299	4.0	85.0
1960	15,295	15,926	31,221	15.4	36,840	3.1	84.7
Average annual change 1980-87				2.6%		2.4%	
1970-79				3.9		3.6	
1960-69				2.3		2.0	

[1] Excludes hardpressed board, construction paper and board, and wet machine board.
e = Estimate.

Source: American Paper Institute.

U.S. exports, the strong dollar coupled with a booming economic expansion encouraged a flood of imports into the U.S. in 1983 and 1984. Overall imports of paper, board, pulp, and products rose 12.1% in 1983 to 12.7 million tons. The flood continued in 1984, as total industry imports rose another 19.5% to 15.2 million tons. Printing and writing paper imports attracted to the U.S. by the strong dollar grew 51% in 1983 and another 78% in 1984, jumping in two years from just 764,000 tons in 1982 to over 2 million tons in 1984.

Newsprint and market pulp import markets, though dominated by the Canadians, were also strong enough during this period to attract attention from offshore. Canadian shipments of newsprint to the U.S. grew 9.1% in

HISTORICAL U.S. WOODPULP PRODUCTION, CAPACITY, AND OPERATING RATES

(000 short tons)

	Production*			Total* capacity	Operating rate
	Total*	Captive	Market		
1987	59,564	51,436	8,128	60,814	97.9%
1986	57,017	49,503	7,514	59,750	95.4
1985	54,147	47,347	6,800	58,641	92.3
1984	55,471	48,572	6,899	57,742	96.1
1983	52,454	45,928	6,526	56,143	93.4
1982	49,334	43,602	5,732	56,125	87.9
1981	52,042	45,839	6,203	54,891	94.8
1980	50,734	44,269	6,465	53,215	95.3
1979	49,366	44,688	4,678	51,637	95.6
1978	46,888	41,726	5,162	49,788	94.2
1977	46,648	41,828	4,820	49,910	93.5
1976	45,385	40,515	4,870	48,759	93.1
1975	40,584	36,240	4,344	46,659	87.0

* Includes paper-grade, dissolving/special alpha pulps, but excludes defibrated/exploded pulps, screenings, and fiber other than wood.

Source: American Paper Institute.

TOP PRODUCING STATES IN 1986

(000 short tons)

PULP		PAPER		PAPERBOARD	
Georgia	6,813	Wisconsin	4,235	Georgia	4,769
Alabama	6,069	Maine	3,383	Alabama	3,052
Louisiana	4,826	Washington	2,632	Louisiana	2,943
Washington	4,285	Alabama	2,241	Virginia	2,039
Florida	3,611	Pennsylvania	1,768	Florida	2,036
North Carolina	3,256	Louisiana	1,718	South Carolina	1,937
Texas	2,982	Oregon	1,611	Oregon	1,861
Oregon	2,948	Michigan	1,534	Ohio	1,385
Virginia	2,925	New York	1,475	Michigan	1,300
South Carolina	2,744	Georgia	1,453	Tennessee	1,223

Note: Production figures for several top-producing states are excluded by the Dept. of Commerce to avoid revealing data for individual companies, biasing the list above against states with a small number of major producers. Such states include Texas, Mississippi, and South Carolina.

Source: Bureau of the Census.

1984, while overall U.S. newsprint imports climbed 14.1%. Woodpulp imports from all sources grew 9.7% in 1984, while shipments from Canada posted an 8.0% increase.

In the poorer market conditions of 1985, offshore producers were cushioned to some extent by the strong U.S. dollar. Domestic coated paper producers, for example, enjoyed strong demand in 1985 but were unable to raise prices because of a surge of European imports. Overall, imports rose 3.2% in 1985 thanks to a 5.2% increase in paper imports. Printing and writing papers declined 6.4%, but they were still very high by historical standards.

As the dollar weakened in late 1985, giving a boost to U.S. exports, the import situation remained relatively

INVENTORY LEVELS FOR PULP, NEWSPRINT, AND CONTAINERBOARD

	Norscan producer[1] pulp stocks (000 metric tons)	U.S. consumer newsprint stocks[2] (000 metric tons)		U.S. container-board inventories[3] (000 short tons)	
			(days)		(weeks)
1987					
Dec	691	1,417	44	2,396	5.3
Sept	856	1,508	41	2,437	5.5
June	795	1,405	44	2,383	5.6
Mar	867	1,367	40	2,391	5.4
1986					
Dec	870	1,268	42	2,134	5.3
Sept	920	1,451	41	2,344	5.8
June	960	1,369	44	2,394	6.1
Mar	1,133	1,405	42	2,489	6.1
1985					
Dec	1,329	1,394	46	2,469	6.6
Sept	1,393	1,519	45	2,694	7.0
June	1,472	1,417	50	2,945	7.6
Mar	1,800	1,545	49	2,955	7.7
Year-end					
1984	1,619	1,329	45	2,442	7.1
1983	1,207	1,179	42	2,415	6.5
1982	1,603	1,258	47	2,524	7.6
1981	1,430	1,477	56	2,729	9.4
1980	949	1,090	42	1,984	6.2
1979	616	877	34	1,979	6.2
1978	903	971	38	1,961	5.8
1977	2,083	1,071	43	2,437	7.2
1976	2,825	1,209	52	2,527	8.1
1975	2,011	911	44	2,185	7.2
1974	611	1,061	48	2,323	8.2
1973	629	757	32	1,595	4.7
1972	1,149	667	26	1,603	5.1
1971	1,618	885	38	1,639	5.7
1970	647	944	42	1,879	7.0
Year-end averages					
1980-87	1,212	1,302	46	2,387	6.8
1970-79	1,309	935	40	2,013	6.5

1. Chemical paper-grade market pulp stocks at North American/Scandinavian producer mills (source: American Paper Institute).
2. Estimated U.S. publisher stocks of newsprint and days of supply (source: Canadian Pulp & Paper Assn.).
3. Containerboard inventories at box plants and mills and weeks of supply (source: Fibre Box Assn.).

stable. Overall imports climbed another 4.0% in 1986, with printing and writing papers posting a 6.1% increase. Pulp import growth was a moderate 2.6% overall, but Canadian shipments climbed 3.1%.

In 1987, total industry imports climbed a strong 7.5%, even as the dollar continued to weaken. Despite the dollar's slide, many European exporters of printing and writing papers maintained their U.S. shipments. In addition, Canadian shipments to the U.S., accounting for half of printing and writing imports, continued to benefit from the even weaker Canadian currency. Strong demand and tight markets resulted in an 18.8% increase in printing and writing papers imports, while Canadian newsprint shipments to the U.S. jumped 5.2%.

Outlook for 1988. Printing and writing papers imports were up 26% in the first quarter, reflecting strong demand. However, newsprint imports dropped 0.5% and pulp imports 2.4% so that total industry imports for the quarter were only 2.1% above year-earlier levels. Imports of coated printing papers from Canada, Finland, and Germany

U.S. PAPER INDUSTRY EXPORTS, IMPORTS, AND NET TRADE BALANCE

	1987		1986		1985		1978	
	Tons (000)	Value ($ million)	Tons (000)	Value ($ million)	Tons (000)	Value ($ million)	Tons (000)	Value ($ million)
EXPORTS								
Woodpulp	4,889	2,259	4,458	1,662	3,795	1,354	2,599	817
Paper	921	776	884	643	779	594	543	416
Newsprint	340	210	392	195	314	131	82	30
Printing/writing	249	243	191	185	203	202	266	209
Packaging & industrial	294	293	284	241	244	243	173	159
Tissue	38	31	17	21	18	18	21	18
Paperboard	3,550	1,445	3,328	1,168	2,733	952	2,282	662
Kraft linerboard	2,297	812	2,196	642	1,807	481	1,540	344
Bl. packaging paperboard	648	408	571	360	518	333	441	204
Other paperboard	275	102	234	79	163	56	98	28
Recycled paperboard	331	123	320	84	246	82	204	86
Total paper/paperboard	4,471	2,221	4,212	1,811	3,512	1,546	2,825	1,078
Converted products	725	823	526	686	491	680	477	452
Construction & wet machine	107	59	94	52	69	40	72	30
Wastepaper	4,422	[illegible]	3,749	411	3,286	349	1,500	146
Total industry exports	14,614	5,915	13,039	4,622	11,153	3,969	7,473	2,523
IMPORTS								
Woodpulp	4,850	2,069	4,582	1,601	4,466	1,521	4,024	1,086
Paper	11,765	5,769	10,925	5,052	10,637	4,907	8,592	2,562
Newsprint	8,987	4,121	8,588	3,682	8,497	3,639	7,484	2,112
Printing/writing	2,410	1,412	2,029	1,180	1,913	1,116	958	385
Packaging & industrial	310	192	243	146	172	116	138	59
Tissue	58	43	66	44	56	36	12	6
Total paperboard	361	127	281	88	184	56	100	18
Total paper/paperboard	12,126	5,896	11,206	5,140	10,821	4,963	8,692	2,580
Converted products	402	933	390	789	284	623	89	174
Construction & wet machine	309	99	340	107	416	112	332	59
Wastepaper	127	19	99	11	87	10	18	1
Total industry imports	17,814	9,016	16,617	7,648	16,074	7,229	13,155	3,900
NET TRADE BALANCE (deficit)								
Woodpulp	39	190	(124)	61	(671)	(167)	(1,425)	(269)
Paper/paperboard	(7,655)	(3,675)	(6,994)	(3,329)	(7,309)	(3,417)	(5,867)	(1,502)
Total industry	(3,200)	(3,101)	(3,578)	(3,026)	(4,921)	(3,260)	(5,682)	(1,377)

Source: American Paper Institute; Dept. of Commerce advanced strongly in 1987 due to strong demand from commercial printers. Demand for these grades will remain strong in 1988 because of the U.S. presidential election campaign, but the lower value of the dollar will make it harder for European suppliers to maintain market share. Furthermore, European demand has been booming, making markets at home more attractive. Pulp imports to the U.S. may slow in 1988, according to one analyst, because of the continuing rise in the Canadian dollar, which makes other markets more attractive.

HISTORICAL U.S. PAPER AND PAPERBOARD PRODUCTION, IMPORTS, EXPORTS, AND APPARENT CONSUMPTION 1950-87

	Production[1]	Imports[1]	Exports[1]	Apparent consumption[2]	Real GNP (billion 1982$)	Ratio consumption to real GNP (000 tons/bil.$)	Population (millions)	Per capita consumption (lb/capita)
1987	74,453	12,528	5,197	81,784	3,820.4	21.41	243.8	670.9
1986	70,861	11,597	4,593	77,865	3,713.3	20.97	241.6	644.6
1985	67,030	11,105	4,008	74,132	3,607.5	20.68	239.3	619.6
1984	68,468	10,576	4,309	74,734	3,501.4	21.41	237.0	630.7
1983	65,015	8,509	4,501	69,023	3,279.1	21.05	234.8	587.9
1982	59,326	7,603	4,187	62,742	3,166.0	19.82	232.5	539.7
1981	62,260	7,942	4,561	65,641	3,243.7	20.16	229.7	571.5
1980	61,147	8,304	5,148	64,303	3,187.2	20.12	227.7	564.8
1979	61,271	8,738	3,610	66,399	3,192.3	20.74	225.1	590.0
1978	58,744	8,781	3,301	64,224	3,115.2	20.56	222.6	557.0
1977	56,823	7,293	3,171	60,945	2,958.6	20.54	220.2	553.5
1976	54,994	7,042	3,388	58,648	2,826.7	20.75	218.0	539.5
1975	48,147	6,165	3,050	51,262	2,695.0	18.97	216.0	474.6
1974	55,926	7,970	3,720	60,176	2,729.3	21.99	213.9	562.7
1973	56,383	8,019	2,965	61,437	2,744.0	22.37	211.9	579.9
1972	53,886	7,567	3,019	58,434	2,608.5	22.38	209.9	556.8
1971	49,782	7,319	3,076	54,025	2,484.8	21.73	207.7	520.2
1970	48,758	7,057	2,780	53,035	2,416.2	21.93	205.1	517.2
1969	49,853	7,210	2,702	54,361	2,423.3	22.41	202.7	536.4
1968	47,110	6,792	2,587	51,315	2,365.6	21.68	200.7	511.4
1967	43,745	6,916	2,053	48,608	2,271.3	21.40	198.7	489.3
1966	43,904	7,327	1,903	49,328	2,208.3	22.34	196.6	501.8
1965	40,489	6,549	1,736	45,302	2,087.6	21.70	194.3	466.3
1964	39,066	6,154	1,661	43,559	1,973.3	21.57	191.9	454.0
1963	35,914	5,637	1,302	40,249	1,873.3	21.49	189.2	425.5
1962	34,407	5,719	1,154	38,922	1,799.4	21.66	186.5	417.4
1961	32,548	5,663	1,175	37,036	1,708.7	21.68	183.7	403.2
1960	31,221	5,610	990	35,841	1,665.2	21.52	180.7	396.7
1955	26.772	5,313	805	31,280	1,485.2	21.06	165.9	377.1
1950	21,563	4,973	337	26,199	1,210.3	21.65	152.3	344.0

1. 000 tons. Excludes wet machine board, construction paper and board, and hard pressed board.
2. Apparent consumption (new supply) = production + imports – exports.

Source: American Paper Institute, Dept. of Commerce.

ANTICIPATED SCHEDULE OF TARIFF REDUCTIONS FOR SELECTED GRADES, 1988-93

Canadian tariffs on imports from the U.S.

	1993	1992	1991	1990	1989	1988
Printing papers						
cut to size	0.0%	1.6%	3.2%	4.8%	6.4%	8.0%
not cut to size	0.0	1.3	2.6	3.9	5.2	6.5
Writing papers	0.0	1.3	2.6	3.9	5.2	6.5
Coated groundwood	0.0	0.5	1.0	1.5	2.0	2.5
Recycled boxboard	0.0	1.8	3.6	5.4	7.2	9.2
Linerboard	0.0	1.3	2.6	3.9	5.2	6.5
Solid bleached board	0.0	1.3	2.6	3.9	5.2	6.5
Corrugating medium	0.0	0.8	1.6	2.4	3.2	4.0
Unbleached kraft paper	0.0	0.8	1.6	2.4	3.2	4.0
Bleached wrapping papers	0.0	1.8	3.6	5.4	7.2	9.2
Sanitary papers (rolls)	0.0	1.3	2.6	3.9	5.2	6.5
cut to size	0.0	2.0	4.0	6.0	8.0	10.2
Folding cartons	0.0	2.0	4.0	6.0	8.0	10.2
Corrugated boxes	0.0	1.8	3.6	5.4	7.2	9.2
Paper bags	0.0	1.8	3.6	5.4	7.2	9.2

U.S. tariffs on imports from Canada

	1993	1992	1991	1990	1989	1988
Bristols, drawing	0.0%	0.4%	0.7%	1.0%	1.3%	1.6%
Carbonizing paper						
15 gm² and under	0.0	0.5	1.0	1.5	2.0	2.6
over 15 g	0.0	0.4	0.8	1.2	1.6	2.0
Cover, writing	0.0	0.4	0.9	1.4	1.9	2.4
India, bible papers						
less than 40 g	0.0	0.4	0.7	1.0	1.3	1.6
40 g to 150 g	0.0	0.2	0.6	1.0	1.4	1.8
Coated printing papers						
woodfree	0.0	0.5	1.0	1.5	2.0	2.5
groundwood, LWC	0.0	0.5	1.0	1.5	2.0	2.5
Sulfite wrapping	0.0	0.4	0.9	1.4	1.9	2.4
Corrugating medium	0.0	0.8	1.6	2.4	3.2	4.0
Packaged sanitary	0.0	1.3	2.3	3.3	4.3	5.3

Source: Canadian Pulp & Paper Assn.

PRICES

Prices for paper, paperboard, and converted products tend to weaken or decline in recessions and to rise strongly in economic recoveries. Fiber prices are even more volatile, with wastepaper tending to lead economic cycles and woodpulp to lag them.

Pulp and paper prices rose sluggishly during the first half of the 1980s because of back-to-back recessions in the early years of the decade and the strength of the U.S. dollar in 1984 and 1985. The strong dollar attracted more imports of paper into U.S. markets and made it increasingly difficult for U.S. and Canadian mills to export market pulp and paperboard. The dollar's impact on pulp, paper, and board prices was as severe as any recession. In 1985, prices for paper rose only 0.2% from the previous year, according to the Dept. of Commerce's Bureau of Labor Statistics (BLS). Paperboard prices declined 4.8%, and woodpulp prices plunged 12.6%.

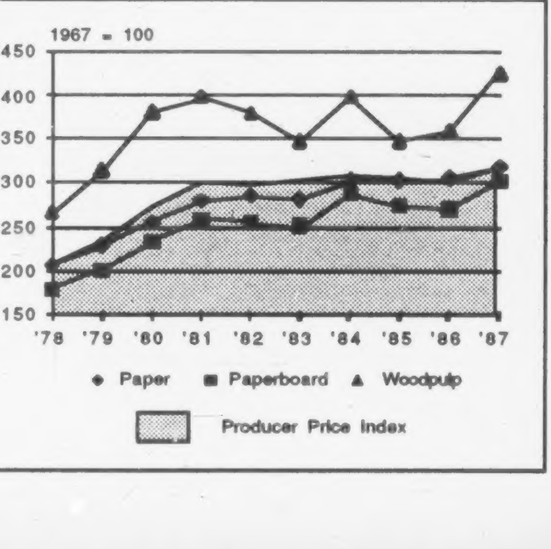
The subsequent slide in the value of the dollar has had exactly the opposite effect. The woodpulp price index shot up 25.0% between the first quarter of 1986 and the same quarter of 1987. Over the same period, paperboard prices jumped 9.6% as containerboard neared its 1984 high, and paper prices rose 4.7% despite weakness due to overcapacity in the printing and writing papers sector. New records were posted for several grades in 1987 as demand strengthened and the dollar continued to drift downward. The woodpulp index jumped 18.4% overall in 1987, while wastepaper climbed 27.7%. Paperboard prices for the year were up 10.8% from 1986, and paper grades posted a 4.2% increase.

Pulp, paper, and converted products have proven a little more resistant than the overall producer price index to the deflationary pressures of the 1980s, with prices rising 4.6%/year on average for pulp, paper, and converted products vs 4.0%/year for all industrial commodities. Over the long term, however, paper industry prices have generally kept pace with the overall index, rising an average of 6.6%/year since 1970 vs 6.7%/year for all industrial commodities.

PULP UPS AND DOWNS

Pulp prices are highly cyclical and tend to lag fluctuations in the world economy by as much as two years. One reason is that integrated producers are usually net buyers of pulp in strong markets but net sellers in times of weakness, causing sharp swings in supply and demand. Other factors include producer inventory levels, operating rates, and changes in average manufacturing costs. Historically, pulp prices have risen when the ratio of shipments to capacity reaches 87% to 88% and North American and Scandinavian producer inventories have dropped to about 1.2 million tons. Exchange-rate fluctuations have also had an impact on pulp prices, which are quoted mainly in U.S. dollars.

PAPER INDUSTRY PRICE INDEXES
vs ALL COMMODITIES



Pulp prices have not fared well in the 1980s. The BLS index for woodpulp climbed just 4.5%/year in the 1980-87 period, far below the 13.8% annual growth of the 1970s.

Following a decade of stability, pulp pricing changed drastically in the 1970s as a result of growing market tightness and a sharp escalation in production costs, particularly for energy and wood, in the 1973-74 and 1978-80 periods. After reaching a low of about $330/ton in the 1978 downturn, benchmark northern bleached softwood kraft (NBSK) list prices rose for eight consecutive quarters, hitting $545/metric ton (c.i.f. northern Europe) by 1980. This represented a 68% rise from the 1977 trough.

Subsequent attempts to raise prices proved unsuccessful, however, and the official $545 list price that had been in effect for two years broke in the second quarter of 1982 and plummeted to $400 to $410/ton in the first quarter of 1983. The 26% decline was even worse than the 1977-78 drop. Exchange rates played a major role in the decline, as the strong dollar undermined pulp prices by giving Scandinavian and nontraditional producers a cost advantage, allowing them to cut prices to add market share. At the same time, the strong dollar made pulp more expensive for buyers with weak currencies, making them more resistant to increases. While the U.S. dollar price dropped 26% from 1980 to 1982, the price of pulp in pounds sterling, liras, and francs actually rose about 8%, and the West German mark price declined only 11%.

Pulp prices firmed only slightly in 1983, but a labor dispute in British Columbia sparked a recovery to $540/ton for NBSK in Europe in the first half of 1984. However, overproduction later in the year, coupled with a large bulge of new capacity, drove the price back down to a low of about $390/ton by early 1985.

Chemical paper-grade pulp prices climbed four consecutive quarters in 1986 as the U.S. dollar weakened and as demand strengthened. The declining dollar reversed the cost advantage of Scandinavian producers and made price increases easy to swallow for overseas customers. NBSK prices rose to $520/metric ton during the last quarter of 1986—a 33% increase for U.S. customers but only 3% in Japan and 4% in Fed. Rep. Germany.

Producers followed up in 1987 with four more increases, bringing the price of NBSK in Europe to $635 by the fourth quarter. The increase was held to $610 in the U.S., where pulp buyers had not been protected from price increases by the falling dollar.

PRICE INDEXES FOR U.S. PULP, PAPER, AND PRODUCTS vs ALL INDUSTRIAL COMMODITIES

(1967 = 100)

	All industrial commodities	Pulp, paper, & products*	Woodpulp	Wastepaper	Paper	Paper-board	Converted products
1987	320.0	312.3	424.7	220.6	319.1	300.9	303.3
% change	5.9%	6.3%	18.4%	27.7%	4.2%	10.8%	4.8%
1986	302.3	294.0	356.6	172.8	306.2	271.4	289.4
% change	–2.1%	0.7%	2.8%	16.1%	0.9%	–1.2%	0.5%
1985	308.8	292.0	347.0	148.9	303.5	274.6	288.1
% change	–0.5%	–0.4%	–122.6%	–38.0%	0.2%	–4.8%	2.5%
1984	310.3	293.3	397.2	240.1	302.9	288.3	281.2
1983	303.1	271.4	346.7	139.7	281.9	250.5	265.4
1982	299.3	273.2	379.0	121.2	286.3	254.9	264.4
1981	301.4	270.8	397.1	175.7	279.8	258.1	258.8
1980	274.8	250.6	380.3	208.7	256.8	234.6	238.5
1979	236.3	220.2	314.3	206.6	229.7	202.1	209.6
1978	209.4	195.5	266.5	191.2	206.1	179.4	186.3
1977	195.1	187.4	281.1	187.2	194.3	176.5	176.5
1976	182.3	180.8	286.0	184.9	182.2	176.3	170.0
1975	171.5	171.9	283.4	110.2	172.9	170.3	161.8
1974	153.8	152.8	217.8	265.6	138.6	152.2	144.9
1973	125.9	122.5	128.3	197.4	121.4	115.1	121.6
1972	117.9	113.7	111.5	133.6	116.3	105.5	113.6
1971	114.0	110.4	112.0	112.1	114.1	102.4	109.7
1970	110.0	108.5	109.5	125.0	111.0	101.1	107.9
Average annual rate 1970-87	6.7%	6.6%	9.7%	9.3%	6.6%	7.0%	6.4%

* Excludes construction grades.

Source: Bureau of Labor Statistics.

WEAKNESS IN SOME PAPER GRADES

Paper weathered the last recession better than other industry products, but prices have suffered in more recent years from overcapacity in key printing and writing grades. The BLS price index for paper grades rose an average of 4.3%/year during the 1980-87 period, compared with 8.4% annual growth in the 1970s.

Newsprint. In October 1982, newsprint prices fell for the first time since the Great Depression, dropping from the $500/metric-ton list price established in mid-1981 to $468/metric ton. Overcapacity forced the dropoff, while competition from other publication grades (also selling for less because of overcapacity) made already soft markets worse. The economic recovery boosted consumption, allowing producers to push the list price back up to $500 in mid-1983, but transaction prices did not firm to that level until the 10-week British Columbia shutdown in the first quarter of 1984.

Another price hike later in the year brought newsprint to a list of $535/ton, but slower growth and publisher inventory building combined to kill an attempted increase in January 1985. Mills tried to raise prices six more times in 1985, but all six attempts failed. Discounting increased as markets remained soft and imports of cheap offshore newsprint picked up.

Gradually improving demand helped markets firm up in 1986, and producers were finally able to push through a price hike in October to a list of $570, although the increase was not implemented fully until early 1987.

Markets continued to strengthen throughout 1987, and producers were able to increase prices on July 1 and again on January 1, 1988. The July increase brought the list price up to $610 in the eastern U.S., and the January hike added another $40. Transaction prices continued significantly below list, in the range of $570 to $610 at the beginning of 1988.

Coated paper. Heavy demand kept the coated groundwood industry running virtually flat out in the late 1970s, allowing a steady series of price increases after the 1974-75 recession. However, a heavy influx of new capacity and lower demand because of the recession caused prices to flatten in 1981 and 1982, forcing a price rollback in early 1983. But demand quickly outpaced new capacity as the recovery picked up steam, allowing producers to restore prices and push through two increases in 1984. Demand for coated free-sheet was almost as strong, and mills were able to raise prices in the fourth quarter of 1983, in January 1984, and again in the second quarter of 1984.

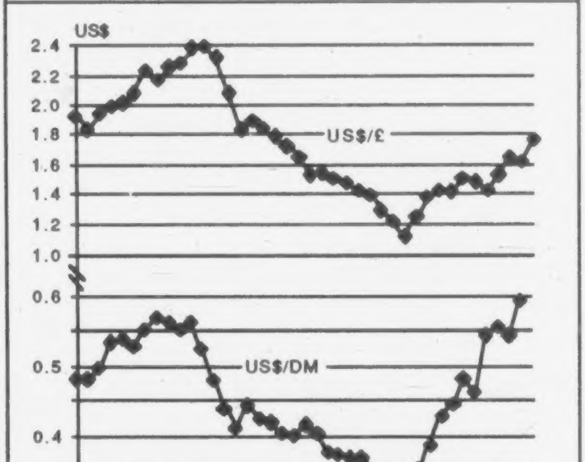
Coated groundwood producers raised prices again in early 1985, but fewer orders and import pressure sent prices back to late-1984 levels by early 1986. Overcapacity struck both free-sheet and groundwood grades later that year, although strong demand growth helped cushion the effects, especially for premium grades. By early 1987, both sectors were forced to roll back prices.

That distressing market situation turned around quickly at the end of the second quarter, helped by the conversion of some groundwood tonnage to free-sheet and the temporary production of uncoated papers by a few producers. A $50 to $70/ton increase was implemented successfully on July 1 for coated groundwood grades, and demand continued to soar through the end of the year.

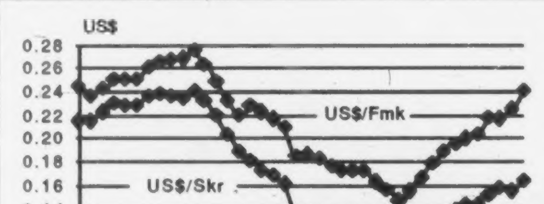
Uncoated free-sheet. Uncoated free-sheet prices came under heavy pressure during the recession, with deep cuts in prices for all but the premium grades. As with coated papers, however, the booming recovery allowed producers to regain lost ground. Prices went up in the last quarter of 1983 and again in the following quarter.

Cheap imports and a spurt of new capacity toward the

U.S. DOLLAR vs SELECTED EUROPEAN BUYERS' CURRENCIES



U.S. DOLLAR vs EUROPEAN SELLERS' CURRENCIES



SELECTED U.S. PULP, PAPER, AND CONVERTED PRODUCT PRICES

	$/short ton domestic market—unless otherwise indicated					Percentage change from year earlier			
	4th Q 1987	4th Q 1986	4th Q 1985	4th Q 1984	4th Q 1983	4th Q 1987	4th Q 1986	4th Q 1985	4th Q 1984
PULP									
Bleached softwood kraft—northern	$610	$480/520	$400*	$510*	$440	22.0%	25.0%	–21.6%	15.9%
Bleached softwood kraft—southern	585	490	360	475	415/425*	19.4	36.1	–24.2	13.1
Bleached hardwood kraft—southern	565	460	320*	450*	390/400	22.8	43.8	–28.9	13.9
PAPER									
Newsprint (30-lb East)	(570)	454/499*	485*	485	453*	19.6	–1.8	n.c.	7.1
Directory (22.5-lb white)	720	670	670	670	654	7.5	n.c.	n.c.	2.4
Coated publication paper									
No. 1 (+70-lb sheets)	1,440/1,460	1,375*	1,375*	1,310/1,375	1,250	5.5	n.c.	2.4	7.4
No. 5 (34-lb rolls)	890	860*	931*	890	782	3.5	–7.6	4.6	13.8
Uncoated free-sheet									
Book paper (No. 3 offset, +45-lb sheets)	850	850	(800)	(880)	840	n.c.	6.3	–9.1	4.8
No. 1 (watermarked, +20-lb sheets)	960	985	985	985	960	–2.5	n.c.	n.c.	2.6
Forms bond (15-lb rolls)	760	720	(600)	(693)	745	5.6	20.0	–13.4	–7.0
Tissue (BLS index)	113.5	111.1	107.8	107.5	102.5	2.2	3.1	0.3	4.9
Unbleached kraft shipping sack (+50 lb)	480/490	(420/430)	360/375*	390/410*	380/410	14.1	15.6	–8.1	1.3
PAPERBOARD									
Unbleached kraft linerboard (42-lb East)	380	320	250/260	320/350	290	18.8	25.5	–23.9	15.5
Semichemical medium (26-lb East)	350/360	290/300	240	310*	280	20.3	22.9	–22.6	10.7
Folding boxboard									
Clay-coated recycled (20-pt rolls)	390/430	380/420	350/400	370/425	370/425	2.5	6.7	–5.7	n.c.
Solid bleached sulfate (15 pt, C1S, 80 brite, rolls)	625/660	570/625	500/590	590/665	590/625	7.5	9.6	–13.1	3.3
CONSTRUCTION GRADES									
Building paper & board (BLS index)	271.4	263.4	255	254.9	253.3	3.0	n.a.	0.0	0.6
CONVERTED PRODUCTS									
Corrugated price trend (FBA index)	44.86	39.63	38.14	42.6	37.74	13.2	3.9	–10.5	12.9

* = Discounting below list prices.
( ) indicates estimated transaction prices where most volume is moving significantly below list.
n.c. = No change.
n.a. = Not available.

Sources: *Pulp & Paper Week*, Bureau of Labor Statistics, Fibre Box Assn.

end of the year undercut prices during 1984. By the end of the year, 50-lb offset was down as low as $560, where it remained until prices in general began to improve in mid-1985. Prices firmed across the uncoated free-sheet spectrum as 1985 progressed, and in 1986 producers raised prices in April and again in July. Demand was strong enough to support the increases despite overcapacity caused by the completion of several major expansion projects.

However, in the first half of 1987, that new capacity came back to haunt producers, as prices plummeted in the face of weakened demand. An attempted price hike failed at the end of the first quarter, sending prices back to late-1986 levels with sales typically about $80/ton below list. Overcapacity and competitive price cutting delayed another increase until September 1, by which time markets had tightened considerably, thanks in part to labor problems. With little sign of an economic slowdown later in the year, producers planned another increase for first-quarter 1988.

Brown paper. Unbleached kraft paper has been the weakest segment in recent years, particularly the heavier-weight grades, which are subject to competitive pressure from swing linerboard machines producing kraft papers during slow periods. Prices for 70-lb grocery sack paper fell from a prerecession peak of about $310/short ton to a discounted $240/short ton in late 1982. Multiwall kraft sack paper also suffered during the downturn due to weakness in key markets such as construction and agriculture. Prices picked up along with the economy in 1983, as swing machines returned to linerboard production and inventories dropped to normal levels.

With mills running full, producers were able to push through sharp runups in some grades. Grocery sack prices surpassed prerecession levels in early 1984, but another increase to bring prices into parity with lightweight linerboard by early summer never fully took effect. A $30/ton first-quarter increase for multiwall sack paper prices also failed to take hold as agricultural and construction markets remained sluggish.

Grocery bag and sack paper prices began to deteriorate in late 1984 as the linerboard market started to soften, and multiwall shipping sack paper prices also weakened further. By spring 1985, renewed swing production on linerboard machines had pushed the price of 70-lb grocery sack paper down to $260/ton or less. By summer, some multiwall paper was being discounted to $360/ton and lower.

Closure of several kraft paper machines tightened the supply/demand balance beginning in mid-1985, and producers responded with a steady stream of increases on grocery bag and sack grades. As demand stayed strong, loss of market share to plastics was the only constraint on prices. Grocery bag and sack paper prices rose in September 1985, and producers pushed through successive increases in January, April, and October of 1986, as well as February of 1987. Multiwall sack paper prices also climbed, with increases during the first and third quarters of 1986 and the first quarter of 1987.

The February 1987 increases brought 70-lb prices to about $400/ton (the same as lightweight linerboard) and 50-lb multiwall paper to $450 to $460/ton. Markets stayed very tight into 1987, and kraft paper producers successfully implemented a $30/ton price increase for most grades in September, again on the heels of a linerboard increase. The increase raised 70-lb grocery sack paper to the $425 to $435/ton range and 50-lb multiwall to $480 to $490/ton.

PAPERBOARD BOUNCES BACK

Paperboard prices have climbed an average of 5.4%/year during the 1980s, down from an 8.2%/year rate in the previous decade. Hurt by the strong dollar, prices on average declined 4.8% in 1985 and another 1.2% in 1986. Prices bounced back in 1987, however, rising 10.8% thanks to strong domestic demand and a weaker dollar.

Containerboard. Both linerboard and corrugating medium suffered sharp drops during the recession, with 42-lb linerboard prices falling from $300/ton in early 1981 to $250/ton and lower by late 1982. Corrugating medium took a similar plunge. Prices began climbing again in 1983, but producers were not able to regain old levels until a February 1984 hike to $320/ton.

An increase to $350/ton attempted in the fall of 1984 only partly took hold because of increasing pressure on the market from the strong U.S. dollar. Containerboard prices began to erode in early 1985, and by summer linerboard was down to $250 to $260/ton, where it stayed for the rest of the year.

Markets tightened in late 1985 thanks to healthy box demand, a surge in export shipments, and production curtailments. Linerboard prices made a strong recovery in 1986, with the base price of 42-lb board rising from $260/ton and below in the first quarter to $320/ton by the third quarter. Strong export demand helped by the decline of the dollar was a major factor in the upturn. Producers easily pushed through a $30/ton hike in January 1987, returning list levels to their fall 1984 peak, and another $30/ton increase was successful in August, raising 42-lb linerboard to $380/ton before zoned discounts. Prices for semichemical medium have generally followed the pattern for linerboard, with a higher-than-usual $10/ton gap between the two grades.

Business was very strong in the final quarter of 1987, with mills operating close to 100% and inventories at mills and box plants down to only five weeks of supply. Consequently, producers announced another $30/ton price hike for the first quarter, bringing 42-lb linerboard to $410/ton before discounts and corrugating medium to $400/ton.

In Europe, U.S. producers successfully pushed through a $35/metric ton increase on heavyweight board in the fall of 1986, raising prices to $405/metric ton before duties. Similar increases were successful in March and August of 1987. The $40/metric ton August increase brought heavyweight linerboard in Europe to $480/metric ton c.i.f. in most markets, while the list for lightweight linerboard in Southeast Asia rose to $515 to $530, depending on the country.

Boxboard. Although more recession-proof than other grades because of various end uses in food packaging, solid bleached folding boxboard prices also fell in 1982, in part because of competition from clay-coated recycled boxboard mills benefiting from the sharp decline in wastepaper prices. In 1983, some producers tried to return to the $625ton list, but the attempt failed. Markets moved up sharply during the last half of 1984, only to erode in 1985. On the recycled side, chipboard prices remained relatively firm during the 1984-85 downturn, but clay-coated board prices were down to the $300/ton range in some spot sales by 1985.

Bleached board prices began to firm up in the first quarter of 1986, and producers raised lists about $30/ton and began to cut back on discounts. A second round of hikes was successful in the third quarter, but a third attempt at the end of the year failed to gain support. After trying and generally failing to raise prices all year, recycled producers got some relief from high wastepaper prices, with a fourth-quarter increase in all areas of the country except the West Coast.

After some initial difficulty, producers raised bleached board prices again in the spring of 1987, bringing folding carton stock prices up $30/ton to a new list of about $645/ton. West Coast recycled board producers also pushed through a price hike, their first in over two years. Bleached board producers took advantage of a pickup in business in late summer to announce another increase of about $35/ton, effective in the fall. At the same time, recycled boxboard producers in the Midwest implemented price hikes, raising transaction prices to the $390 to $430/ton range for most business.

Wastepaper. Wastepaper prices are the most volatile in the paper industry, fluctuating wildly in response to supply and demand. The average annual growth rate for the 1980-87 period was 5.9%, compared with 12.0% during the 1970s. Prices dropped 16% in 1981 and another 31% in 1982, according to BLS data. A 15% increase in 1983 was followed by the largest gain of the decade, 72%, in 1984. Wastepaper prices plummeted 38% in 1985, however, before rising 16% in 1986 and 28% in 1987.

CONVERTED PRODUCTS STEADY

Converted products prices have been more stable than primary grades, holding up better during the recession but missing out on the strong recovery afterward. Prices have risen an average of 4.8%/year since 1980, down from 7.7%/year in the 1970s. That is a little better than paper and paperboard have performed, indicating that converters have been able to pass on raw materials price increases and maintain profit margins over the long term.

Converted products price indexes outperformed paper and board in the recession years, rising 2.1% in 1982 and 0.4% in 1983. Converters were unable to keep pace with increases on paper and paperboard in 1984, however, as converted prices climbed only 6.0%, compared with 15.1% for paperboard and 7.4% for paper. Converters again kept pace with their suppliers during the sluggish 1985-86 period, but since then prices have lagged for converted products in comparison with paper and board. The converted products price index for 1987 was up only 4.8% from the previous year, compared with 10.8% for paperboard, suggesting some renewed and substantial pressure on converters' profit margins.

Corrugated box prices tend to follow domestic swings in containerboard prices, as converters try to pass on higher input costs. Containerboard accounts for about 50% to 55% of the cost of producing a corrugated box. Converter profit margins fattened in 1985, when containerboard prices fell close to 30% and box prices fell only about 12%. Since then, however, box prices have failed to match the steep runup in containerboard prices. After several failed attempts, converters pushed through an 8% increase in the third quarter of 1986. After the January 1987 containerboard price hike, integrated box makers got another 10% increase in box prices in the spring. That returned box prices close to their previous historic high. Under pressure from higher containerboard prices, box makers were fairly successful in pushing through an 8% increase in September.

PROFITABILITY

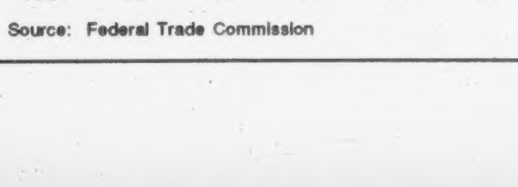
The U.S. pulp and paper industry will look back on 1987 as one of the most profitable in its history. Earnings for the year jumped 47% on a 20% increase in sales, according to a *Pulp & Paper Week* survey of financial reports from 30 companies. The profit surge reflected strong demand that resulted in full-capacity operation and price increases in most grade segments. Industry cost cutting and productivity improvement programs over the last several years also contributed to profitability. Profit margins for the industry climbed to 5.8% for the year, according to preliminary Federal Trade Commission data, the highest level reached since 1979.

"A major external factor affecting sales and earnings favorably in 1987 was the decline of the dollar in relation to other major currencies," said George H. Weyerhaeuser, chairman and CEO, Weyerhaeuser Co. "Sharply higher dollar prices of pulp and paper products traded in world markets drove margins for these products to their highest levels in the 1980s."

Most paper-industry executives are bullish about the first half of 1988 because of the current momentum in the industry. Mills are operating virtually at capacity in many grades, inventories are at moderate to low levels, and price increases for the first quarter were accepted. Companies in 1988 will also benefit from price increases implemented on most grades in the second half of 1987 and from lower tax rates. As George Adler, industry analyst at Smith Barney, Harris Upham Co., said, "Price cutting [in a possible recession] would have to be very severe for paper companies to earn less in 1988 than in 1987."

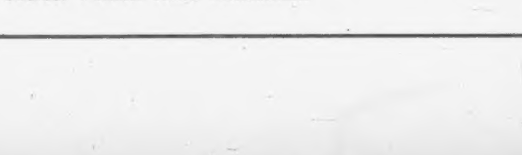
No evidence of an imminent recession can be found in the first-quarter results of U.S. pulp and paper companies. For 29 companies surveyed, first-quarter profits were 61.5% over 1987's first quarter. Sales of $19 billion were 19.3% above the year-earlier period. Companies continued to enjoy firm prices for virtually all paper grades, high operating rates, a sellers' market for pulp, and the benefits of a weak currency.

RETURN ON NET WORTH, 1960-86



Source: Federal Trade Commission

PROFIT MARGIN, 1960-86



Source: Federal Trade Commission

RECORD RESULTS AT MOST COMPANIES IN 1987

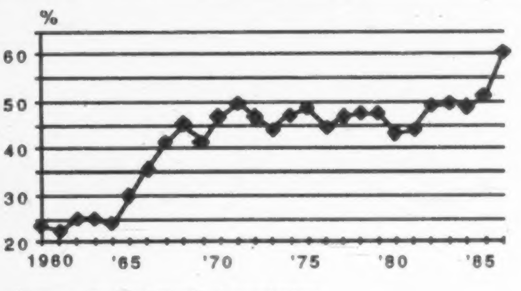
In 1987, Georgia-Pacific Corp. had the highest sales in the industry at $8.6 billion. Earnings for the year amounted to $458 million, a 55% increase that set a record for the company. Chairman and CEO T. Marshall Hahn Jr. said, "Demand for pulp and many paper and board products allowed us to operate our mills at or near capacity for most of the year. Strong demand for linerboard and uncoated free-sheet and our expanded capacity in these products contributed substantially to profitability." Hahn predicted that G-P would continue to see healthy markets for most of its products in 1988: "Home improvement and export markets should keep building products' volume strong, while prospects for pulp and paper remain particularly good because of vigorous domestic and foreign demand."

International Paper Co. showed a 33.4% increase in earnings on a 42% increase in sales. Earnings for the quarter were 10.6% above the year-earlier level. The effect of strikes going on at three of IP's mills and a lockout at another was said to be diminishing. IP was the first to announce a first-quarter increase on kraft linerboard, and it appears confident that other grades will earn increased revenues as well.

Weyerhaeuser Co.'s earnings improved 61% over 1986 levels. The weak dollar helped the company maintain its position as the largest exporter of paper and forest products, with Japan as its biggest customer. Weyco's export sales totaled $1.5 billion, a 36% increase over 1986. George Weyerhaeuser said, "Operating earnings in the company's pulp, paper, and packaging business overall were up 136%. Markets across the entire pulp, paper, and packaging spectrum are continuing to strengthen, and industrial, commercial, and export markets for wood products remain firm."

Great Northern Nekoosa Corp.'s profits increased 135% to $200.6 million (or 88% after excluding a $21.2-million charge taken in 1986) because of stronger demand and prices for such key products as market pulp, linerboard, and newsprint. Improving market conditions during the second half for uncoated free-sheet also contributed to the gain.

LONG-TERM DEBT TO NET WORTH
1960-86



Source: Federal Trade Commission

James River Corp. enjoyed a 48% increase in profits for its fiscal second quarter, ended Oct. 25. The company said a reduced tax rate compared with the previous year was a "major contributor." James River noted that earnings increased in tissue, disposable food service, and paperboard packaging, but they were flat for communication papers and lower for specialty papers and flexible packaging.

Paperboard profits surge. Profits of companies that are heavily involved in containerboard and bleached paperboard increased dramatically in 1987, thanks to very tight markets and a series of successful price increases. Stone Container Corp. enjoyed record net income in 1987 of $161.3 million, a 355% increase over 1986 levels. Sales rose 59% to $3.2 billion. Roger W. Stone, chairman, CEO, and president, said, "Strong demand, coupled with limited additions to industry capacity in recent years, has created a very favorable demand/supply environment." The fourth quarter was the seventh consecutive quarter of higher earnings for Stone and its fifth consecutive new quarterly earnings record. "This is a trend we believe will continue throughout 1988, whereby each quarter of the year should set a new high for that quarterly period," said Stone.

Jefferson Smurfit Corp. reported that its net income for the year more than tripled to $92 million on sales of $1.1 billion. Smurfit's equity in Container Corp. of America, its 50%-owned affiliate, amounted to $44.5 million in 1987, reflecting cost reduction and improved market conditions.

Union Camp Corp.'s profits surged 59.7% for all of 1987 to $207.5 million on sales of $2.3 billion. Strong demand and prices for linerboard and improving markets for white papers were behind the favorable results. Federal Paper Board Co. Inc.'s income jumped 120% to nearly $74 million for 1987 before an $8.2 million extraordinary charge from retirement of debt. The company has been benefiting from strong demand and prices for both bleached board and market pulp.

Sonoco Products Co.'s net income increased 12% over 1986 levels, but it would have shown a greater increase if the company had not had a one-time charge related to the acquisition of Boise Cascade Corp.'s consumer-packaging operations in April 1987. Plant closings and consolidation were expected to result in substantial cost savings during 1988.

Temple-Inland Inc.'s earnings jumped 77% to $141 million on sales of $1.6 billion. The company said its container and containerboard segment more than doubled its previous earnings record.

Strong finish for publication papers. Although some makers of publication papers got off to a slow start in 1987, most finished the year with more than satisfactory earnings.

Mead Corp. almost doubled its earnings for the year. The company said its pulp mills have been sold out since mid-1987. Mead also reported that prices for coated and uncoated paper began to recover in the second half and demand for carbonless copy paper remained strong throughout the year.

Boise Cascade also nearly doubled its 1987 earnings. The company attributed the improvement to strong market conditions for all of its major businesses and to "significant efficiencies stemming from aggressive cost-reduction efforts and restructuring."

Bowater Inc. reported record sales and earnings for the year. The company attributed the good showing to a recovery in newsprint prices and to two price increases on coated paper during the second half as new capacity was fully absorbed.

Pentair Inc. reported that its earnings rose 44% to $21.8 million on sales of $789 million. P.H. Glatfelter Co. enjoyed a 33% increase in earnings to $55 million on increased sales of $423 million. And Mosinee Paper Corp.'s profits rose 22% to $5.7 milion on sales of $215 million.

Tissue profits soar. Scott Paper Co.'s 1987 sales passed $4 billion for the first time in its history, and earnings of $233 million also set a record. Scott said that its operating results in Europe were "excellent," but earnings of its sanitary-papers business in the U.S. showed little growth due to the extremely competitive environment. Scott's S.D. Warren Div. had record sales of $1.1 billion while increasing its market share in the coated-paper business.

U.S. PAPER & ALLIED PRODUCTS INDUSTRY FINANCIAL PERFORMANCE, 1960-86

(million $)

					Financial ratios			
	Net sales	% change from prior year	Net profit after taxes	% change from prior year	Profit margins	Return on net worth	Return on total capital	Debt to net worth
1986*	$74,844	4.4%	$3,280	13.9%	4.4%	10.5%	6.5%	60.6%
1985*	71,465	–0.2	2,880	–4.1	4.0	9.7	6.4	51.4
1984	71,891	8.8	3,015	29.0	4.2	10.7	7.2	49.0
1983*	65,008	9.6	2,327	60.1	3.6	8.5	5.7	49.8
1982	60,293	–3.5	1,460	–53.0	2.4	5.5	3.7	49.2
1981*	62,699	5.3	3,110	53.0	5.0	11.7	8.1	44.1
1980*	56,250	7.2	2,800	–45.4	5.0	11.5	8.0	43.4
Average 1980-86		4.5		7.6	4.1	9.7	6.5	49.6
1979	55,359	11.4	3,723	40.6	6.7	16.0	10.9	47.5
1978*	48,982	18.5	2,598	18.5	5.3	12.5	8.5	47.6
1977*	45,750	6.8	2,367	–1.6	5.2	12.0	8.2	47.0
1976	39,270	22.6	2,270	26.0	5.8	13.2	9.1	44.3
1975	32,044	4.0	1,801	–17.5	5.6	12.1	8.2	48.3
1974*	32,837	16.2	2,287	51.5	7.0	16.8	11.4	47.5
1973*	26,503	13.6	1,441	53.1	5.4	12.9	8.9	44.2
1972	23,324	4.9	941	83.8	4.0	8.9	6.0	46.8
1971*	22,224	5.5	512	–28.8	2.3	5.0	3.3	49.7
1970	21,069	2.2	719	–27.2	3.4	7.0	4.8	46.8
Average 1970-79		10.6		19.9	5.1	11.6	7.9	47.0
1969	20,607	10.0	987	11.0	4.8	9.7	6.8	41.8
1968	18,738	10.9	889	11.7	4.7	9.6	6.6	45.1
1967*	16,900	–0.7	796	–12.6	4.7	8.8	6.2	41.5
1966	17,016	4.9	911	4.8	5.4	10.5	7.7	35.6
1965*	15,217	9.8	753	15.3	4.9	9.2	7.1	30.0
1964	14,771	5.1	754	18.9	5.1	9.1	7.3	23.7
1963	14,050	2.6	634	1.0	4.5	8.0	6.4	24.9
1962	13,698	9.4	628	7.7	4.6	8.1	6.5	25.1
1961	12,525	6.5	583	–0.7	4.7	7.7	6.2	22.6
1960	11,764	–0.5	587	–5.2	5.0	8.4	6.8	23.3
Average 1960-69		5.8		5.2	4.8	8.9	6.8	31.4

* **Revised**—change in corporation structure of the industry. Percent changes for sales and profits are computed from data (not shown) consistent with previous year.

Definitions: Profit margins = after-tax net profit to net sales. Return on net worth = after-tax net profit to net worth. Return on total capital = after-tax profit to net worth + long-term debt. Debt to net worth = long-term debt to net worth.

Sources: Federal Trade Commission; Securities & Exchange Commission; Bureau of the Census. Compiled by American Paper Institute.

Kimberly-Clark Corp. enjoyed a 31% increase in earnings. Fort Howard Corp.'s earnings of $157.7 million on sales of $1.7 billion set new records for the company. Chairman and CEO Paul Schierl said, "The tissue business, which remains Fort Howard's traditional core, has never been healthier. Demand for our tissue products is very high, and capacity is being expanded aggressively."

HISTORICAL PERFORMANCE

Pulp and paper producers can enjoy their current success all the more because of the hard times it follows. Earnings declined almost 63% between 1980 and 1983 in the worst recession in the postwar period. FTC data show that U.S. paper and allied products earnings fell 53% in 1982 alone, twice the decline of 21% suffered in the 1974-75 downturn and on par with the recession of 1970-71 when profits tumbled 56% over the two-year period.

Forest-products operations were the first to be hit in the last recession, when the worst housing decline since World War II began rolling in 1979. Profits on the paper side began to evaporate in the fourth quarter of 1981, as weak demand forced sharp price discounting in major grades. Paper company net income declined 8% in 1981 on sales up 6% from a year earlier, while forest-products companies suffered a 28% drop in earnings for the year. In the depths of the 1982 recession, paper-company profits plummeted an additional 47% on sales that were off by 7%, while forest-products income plunged 65%.

After six consecutive quarters of decline, paper-industry

U.S. PAPER AND FOREST-PRODUCTS COMPANY SALES AND EARNINGS, 1987

($000)

Companies	Sales	% change 1987/86	Earnings[1]	% change 1987/86
Boise Cascade	$3,820,810	2.2%	$182,990	80.2%
Bowater	1,231,002	33.8	81,140	64.1
Champion International	4,614,723	5.2	293,321	46.1
Chesapeake	675,713	12.7	30,153	119.5
Consolidated Papers	742,835	13.8	95,798	9.4
Federal Paper Board	1,025,727	8.1	65,763	257.2
Fort Howard	1,757,728	13.4	157,738	7.8
Georgia-Pacific	8,603,000	19.1	458,000	54.7
P.H. Glatfelter	423,000	48.4	55,000	32.5
Great Northern Nekoosa	2,589,000	27.0	200,600	88.3
International Paper	7,800,000	41.8	407,000	33.4
James River (10/25)	1,286,152	10.8	53,429	47.9
Kimberly-Clark	4,900,000	14.0	325,000	30.9
Longview Fibre (10/31)	569,399	16.8	65,166	94.6
Louisiana-Pacific	1,921,600	27.6	125,000	–33.2
Mead	4,208,800	30.8	218,200	99.6
Mosinee Paper	215,982	10.5	5,714	22.1
Pentair	789,245	26.5	21,860	43.6
Pope & Talbot	426,908	37.6	28,129	77.9
Potlatch	992,077	1.6	87,623	25.3
Scott Paper	4,122,000	19.9	233,800	25.4
Jefferson Smurfit	1,099,465	16.4	91,996	228.5
Sonoco Products	1,312,052	36.1	61,482	12.4
Stone Container	3,200,000	57.5	161,300	355.6
Temple-Inland	1,602,700	23.7	141,400	75.0
Union Camp	2,307,599	12.8	207,483	57.1
Wausau Paper Mills (11/30)	68,884	10.5	3,736	25.5
Westvaco (10/31)	1,903,606	5.1	146,191	35.2
Weyerhaeuser Paper	6,989,829	23.6	446,623	61.4
Willamette Industries	1,431,624	19.3	121,339	62.5
Total	72,631,460	19.9	4,572,974	46.6

1. Income after taxes, from continuing operations, excluding most significant nonrecurring items in both years.

Source: *Pulp & Paper Week.*

earnings began to show faint signs of recovery in the second quarter of 1983, rising 67% above year-earlier levels. Forest-products companies got a much-needed lift from a jump in housing starts and from higher prices for building materials, which boosted profits 73% above 1982 levels. Although lumber prices collapsed in the third quarter due to overcapacity, paper shipments—and prices—improved steadily, and paper and forest-products companies posted increases of 34% and 90%, respectively. As the economic recovery gathered steam late in the year, industry profits took off, rising sixfold among paper companies and almost tenfold for forest-products firms. U.S. paper companies finished the year with profits up 45% compared to 1982, while forest-products firms enjoyed a 90% increase.

Profits continued to improve dramatically as the economy boomed in early 1984, and a number of companies set new records for sales and earnings. Paper companies posted a 59% increase in first-quarter net income. Second-quarter figures were even more spectacular as paper company profits jumped 88%, compared with the year before, on sales up 32%.

Signs of a slowdown in the economy began to appear in the third quarter of 1984, however. Paper-industry production started to weaken in the fourth quarter, and price discounting began to occur in uncoated free-sheet and in market pulp, reflecting excess capacity and the strong dollar. But industry performance was not hurt too much by these negatives, and for 1984 as a whole, earnings jumped 45% on sales that were 15% higher than in 1983.

Overcapacity in some segments and the strong dollar plagued the industry in 1985, causing another downturn in sales and earnings. First-quarter profits were up only 3% on a 6% rise in sales. While coated-paper markets stayed strong, uncoated free-sheet suffered from discounting, and prices for market pulp and linerboard remained weak. Second-quarter earnings dropped 19%, as only those concentrated in coated papers or consumer tissue were able to post gains. U.S. industrial activity remained sluggish in the third quarter, and demand weakness spread to newsprint and some coated grades as papermakers' profits plunged 44%. Ending a year of tough competition and difficult markets, 30 top companies reported earnings down 15% compared with 1984 and sales up a minimal 2%.

Sales and earnings bounced back in 1986, thanks to the steady weakening of the dollar, which began to drop in the fall of 1985. The cheaper dollar helped to firm up export shipments and pricing, which in turn helped the domestic supply/demand balance for many commodity grades and allowed producers to push through some price increases. Cost controls in force at many mills also contributed to improved performance. The first quarter marked the trough of the earnings cycle, as profits dropped another 24% due to continued price weakness in a number of grade segments. Second-quarter income rose 13%, the first increase since the fourth quarter of 1983, and third-quarter profits soared 30% above the previous year on a sales increase of 5%. For the entire year, earnings climbed a solid 34% over 1985 on improved sales of 4%. Producers of market pulp, linerboard, and uncoated free-sheet showed the biggest gains.

FINANCIAL RATIOS

After lagging the average for all manufacturing for two decades, paper-industry return on net worth exceeded the average of the 1974-75 tight-market period. Return on net worth reached a peak of 16.8% in 1974, hovered in the 12% to 13% range from 1975 to 1978, and then hit 16.0% in 1979, according to FTC data. Return on net worth then declined to the 12% level in 1980 and 1981 before plummeting to 5.5% in 1982. Since then, industry return on net worth has been rising on the strength of slowly improving profit margins. The ratio topped 10% in 1984 and 1986, and preliminary data for 1987 show paper-industry return on net worth of 12.6%, the best mark since 1979.

Return on total capital (net worth plus long-term debt) has not kept up with return on net worth, reflecting the heavy debt loads built up by the industry. Long-term debt as a percentage of net worth rose from the low-20% range in the first half of the 1960s to an average of 47% in the 1970s. In 1982, debt to net worth rose to 49% when profits crumbled. Deterioration in this and other financial ratios caused downgrading of credit ratings for a number of major producers. Some companies moved to improve their liquidity in the subsequent upswing, but many major producers remain highly leveraged, with some taking on even more debt to finance large acquisitions. FTC data through 1986 show that debt to net worth has continued to climb, topping 51% in 1985 and then soaring to 61% in 1986.

CAPITAL SPENDING

U.S. paper-industry capital expenditures are headed through the roof in 1988, thanks to record profits, booming markets, and the beginning of an upturn in the capacity expansion cycle for such long-neglected grades as newsprint, market kraft pulp, and kraft linerboard.

According to the Dept. of Commerce's Bureau of Economic Analysis, U.S. pulp and paper companies plan to spend a record $11.29 billion in 1988 on capital projects. That would represent a 26.6% increase over the previous record of $8.92 billion set in 1987. The main factors in the investment upswing are record earnings at many companies, prospects for continued strong demand, and continued competitive advantage from the weak U.S. dollar.

The Dept. of Commerce survey, conducted in the first quarter of 1988, showed virtually no change from a 1987 year-end survey of 1988 spending plans. Papermakers remain bullish about capital spending, despite the October 1987 stock-market crash.

The pace of spending picked up in the fourth quarter of 1987. On an annualized basis, spending hovered in the $8 to $9 billion/year range from the third quarter of 1986 through the third quarter of 1987. In the final quarter of 1987, however, the pace of spending jumped dramatically to $10.02 billion. That was up over 13% from the previous quarter and up almost 17% from the same quarter the previous year. Paper companies plan to sustain this new spending level throughout 1988. Annualized expenditures were expected to reach $10.26 billion in the first quarter, rising to $11.57 billion in the second quarter and to $11.66 billion in the second half.

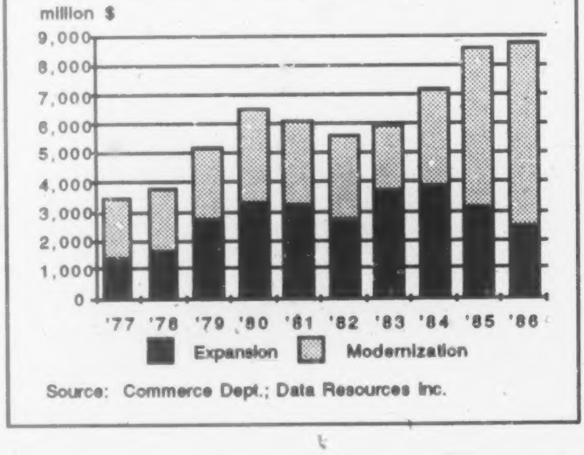
A new survey completed in March 1988 by Data Resources Inc. (DRI) was equally optimistic about the capital-spending outlook. Paper-industry spending was pegged at $11.86 billion for 1988, up 33.7% from 1987. Capital spending in 1989 is still expected to decline, falling 10.1% to $10.66 billion, but this is less of a drop-off than that forecasted in DRI's earlier survey of 1989 spending plans, conducted in September and October of 1987.

HISTORICAL TRENDS

U.S. pulp and paper companies have devoted an increasing portion of their funds to capital improvements over the past decade, both to increase capacity and to reduce costs and improve their products in order to remain competitive with foreign companies. In absolute terms, spending has climbed from $3.48 billion in 1977 to $8.76 billion in 1986, an increase of 152%. Over that period, capital spending has risen from just under 100% of cash flow annually to about 130% of cash flow. To help pay for this increase, companies have boosted their long-term debt significantly, from $8.55 billion in 1977 to $18.92 billion in 1986.

U.S. paper-industry capital spending dropped 26% in the 1971 recession, but it rose in each of the following ten

MODERNIZATION VS EXPANSION IN U.S. CAPITAL SPENDING



Source: Commerce Dept.; Data Resources Inc.

years, even through the severe 1974-75 economic downturn. During this period, environmental compliance was the major engine driving capital outlays. During the 1972-75 period, between 30% and 38% of total primary industry capital spending went for air, water, and solid-waste control, according to the National Council of the Paper Industry for Air & Stream Improvement.

Energy programs to reduce dependence on fossil fuels and to improve efficiency claimed a substantial percentage of industry capital following the oil shocks of the 1970s. A *Pulp & Paper Project Report* roundup in late 1981 counted 35 new power boilers and 19 new recovery boilers either being constructed or under consideration at U.S. mills. That number held steady in 1982—although several installations were deferred—before dropping in 1983 because of the recession.

Since then, cogeneration plants have become a major focus of energy spending. In many cases, these plants are being built, owned, and operated by outside contractors, with the mill simply supplying fuel for the plant and taking the power generated. Such arrangements have kept interest in this type of project strong despite lower energy prices in the 1980s.

Skyrocketing costs. Another major factor in the 14%/year rise in industry capital spending during the 1970s was rapid inflation in construction and capital-goods costs. The following comparisons, though inexact, show how the costs of building new greenfield mills in several key grades have escalated. In 1971, Weyerhaeuser Co. built a new 1,600-tpd containerboard mill at Valliant, Okla., for about $100 million, or about $62,500/daily ton. Ten years later, International Paper Co.'s 2,070-tpd Mansfield, La., mill was completed in 1981 for about $600 million, or about $290,000/daily ton.

Weyerhaeuser completed a 600-tpd kraft market pulp mill at New Bern, N.C., in 1970 for $50 million, or $83,000/daily ton. Great Northern Nekoosa Corp.'s 1,030-tpd greenfield Leaf River market pulp mill, started up in 1984, cost $560 million, or roughly $544,000/daily ton. Also started up in 1984, Union Camp Corp.'s integrated 600-tpd uncoated free-sheet mill at Eastover, S.C., cost $485 million, or $808,000/daily ton. In contrast, Champion International built a $100-million, 500-tpd bleached kraft pulp and paper mill at Courtland, Ala., in 1971 for $200,000/daily ton.

SPENDING PLANS FOR 1987 AND BEYOND

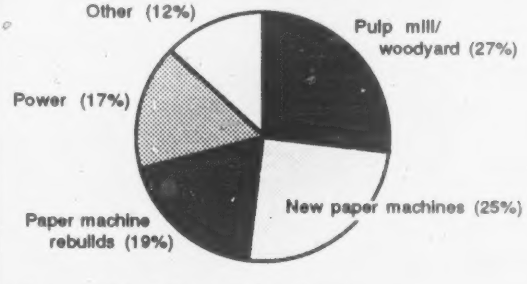
U.S. pulp and paper companies responding to a November 1987 *Pulp & Paper* survey reported plans to spend $8.0 billion on capital modernization and expansion projects during the 1987-89 period. That represents a 19% increase over the the previous year's survey for 1986-88. Production-related expenditures were estimated at $7.6 billion, up 19%, while environmental outlays were expected to total $450 million.

The strongest growth was reported in pulp-mill spending plans, which climbed 70% from 1986. Mills reported plans to spend an estimated $1.9 billion on pulp-mill expansion and modernization projects over the 1987-89 period, up from about $1.1 billion for 1986-88. Pulp-mill projects accounted for 24% of announced spending plans in the 1987 survey, up from only 16% in 1986.

Capacity expansion is the driving force behind the growth in pulp-mill spending. This upswing in expansion plans is a recent phenomenon, with several of the largest projects gaining approval only in late 1987 and in early 1988. Most of the increases will come in 1990 or later.

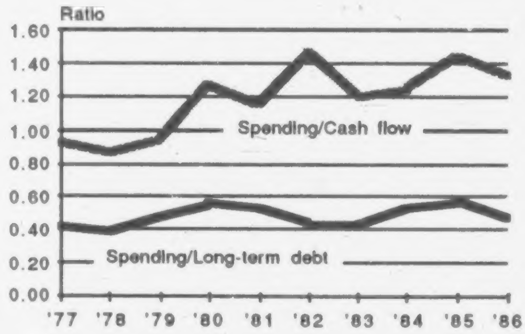
Among integrated papermakers, the kraft paperboard sector is contributing the most to pulp expansion activity, with plans to overhaul aging facilities to control odor and reduce costs and to provide furnish for new paperboard

ESTIMATED CAPITAL SPENDING BY PROCESS AREA



Source: Pulp & Paper Project Report

CAPITAL SPENDING VS CASH FLOW AND LONG-TERM DEBT



Sources: American Paper Institute, Federal Trade Commission, and Bureau of the Census.

capacity. Union Camp is the leader in this regard, with two projects under way to modernize pulp facilities in support of linerboard expansions at Montgomery, Ala., and Savannah, Ga. Major programs are also under way at Federal Paper Board Co. Inc.'s Augusta, Ga., bleached paperboard mill and at Temple-Inland Inc.'s Rome, Ga., linerboard facility.

Mechanical-pulp spending will get a boost from two greenfield newsprint mills, planned by Newsprint South Inc. and Ponderay Newsprint Co., and a major mill modernization at Blandin Paper Co.'s Grand Rapids, Minn., mill. All three projects are scheduled for completion in 1989.

Plans for power-plant spending climbed almost 18% in the 1987 survey to $1.4 billion. Energy-related projects accounted for about 17% of spending reported for the 1987-89 period.

Despite a big jump in the number of cogeneration projects either planned or under way, new power-boiler installations and energy-related improvement programs continue to lag behind the pace set in the early- to mid-1980s. The main factor has been lower prices for oil and natural gas, which have caused the postponement of several projects. Two recent casualties are proposed cogeneration plants at Federal Paper Board Co. Inc.'s Sprague, Conn., mill and at Erving Paper Mills' Erving, Mass., mill. Both projects have been postponed because of lower oil prices, but Federal may proceed with a smaller installation than the 69-MW plant originally planned.

Even with these postponements, however, the cogeneration area remains fertile ground for spending. At least 17 new plants are planned for the 1987-89 period, and several others remain on the drawing board. Two recent announcements came from Boise Cascade Corp., which plans to install a 75-MW power plant at Rumford, Maine, and Southeast Paper Manufacturing Co., which will install a power plant as part of a large-scale newsprint expansion at Dublin, Ga.

Announced spending for paper-machine rebuilds and modifications in the 1987-89 period totaled $1.5 billion, up 18% from the previous year's survey. Spending in this category has risen steadily in recent years and now accounts for about 19% of total outlays, up from 13% in 1985 and only 6% in 1983.

Paper-machine upgrades have played a major role in the industry's modernization efforts since the current economic expansion began in 1982, particularly in the areas of cost cutting, product improvement, and grade realignment. An important trend that has emerged more recently is incremental capacity expansion through rebuilds, especially in the linerboard sector.

At 25% of the total, new paper machines consumed the largest percentage of spending announced for the 1987-89 period. Outlays for new paper machines will top the $2.0 billion mark, up 12% from 1986 spending plans. Six new paper machines and three new paper mills were approved during 1987 for startup in 1989, and four more were tentatively approved for the early 1990s.

CAPITAL SPENDING PLANS OF MAJOR U.S. PAPER COMPANIES

(million $)

	1988	1987	% change
Appleton Papers	$15,000	$75,000	−80.0%
Boise Cascade	250,000	200,000	25.0
Champion International	525,000	345,000	52.2
Consolidated Papers	96,700	84,000	15.1
Great Northern Nekoosa	300,000	220,000	36.4
James River	630,000	504,000	25.0
Kimberly-Clark	400,000	250,000	60.0
Longview Fibre	70,000	65,000	7.7
Mead	200,000	88,000	127.3
Union Camp	300,000	209,000	43.5
Westvaco	375,000	375,000	0.0
Weyerhaeuser Paper	225,000	182,000	23.6
Total	3,386,700	2,597,000	30.4

Source: *Pulp & Paper Project Report.*

U.S. PAPER INDUSTRY CAPITAL SPENDING FORECASTS FOR 1988

(billion $)

	1988e	1987	% change
Commerce Dept.			
Paper & allied	$11.29	$8.92	26.6%
All manufacturing	159.68	145.46	8.8
McGraw-Hill Economics			
Paper & pulp	11.86	8.87	33.7
All manufacturing	163.32	145.18	12.5

e = Estimate.

Sources: Based on surveys conducted from January through March 1988 by the Dept. of Commerce and by McGraw-Hill Economics.

CAPITAL SPENDING BY U.S. PAPER AND ALLIED PRODUCTS ESTABLISHMENTS

(million $)

	Total (SIC 26)	Pulp mills	Paper mills	Paperboard mills	Converting plants		Building paper/board mills
					Paper	Containers & boxes	
1985	$6,276	$745	$2,484	$1,043	$1,218	$764	$21
1984	5,302	600	2,412	680	906	681	21
1983	4,987	916	2,239	527	820	470	15
1982	5,098	659	1,856	1,287	786	496	15
1981	5,202	522	2,435	974	746	499	27
1980	5,128	250	1,897	1,539	775	628	40
1979	4,447	240	1,714	1,229	725	491	48
1978	3,736	195	1,424	1,000	604	496	19
1977	3,295	301	1,115	934	507	421	17
1976	3,010	375	1,044	844	394	335	12
1975	2,718	294	832	807	412	347	26
1974	2,214	136	723	637	315	342	63
1973	1,530	119	508	344	304	227	26
1972	1,335	136	372	314	289	206	19
1971	1,197	135	374	228	262	180	18
1970	1,397	122	503	239	289	227	18

Source: Bureau of the Census.

U.S. PAPER AND ALLIED PRODUCTS COMPANIES CAPITAL SPENDING RELATED TO PROFITABILITY AND CAPACITY UTILIZATION

(million $)

	Capital spending[1]	% change	Net profit after taxes[2]	% change	Operating rate[3]
1987	$8,920	1.7%	$4,989	52.1%	95.4%
1986	8,770	2.1	3,280	13.9	93.7
1985*	8,590	19.1	2,880	–4.1	90.3
1984	7,210	21.8	3,015	29.0	93.6
1983*	5,920	5.7	2,327	60.1	91.4
1982	5,600	–8.3	1,460	–53.0	84.6
1981*	6,110	–6.3	3,110	53.0	91.1
1980*	6,520	24.4	2,800	–45.4	91.9
1979	5,240	37.9	3,723	40.6	94.5
1978*	3,800	9.2	2,598	18.5	92.8
1977*	3,480	16.4	2,367	–1.6	91.4
1976	2,990	2.0	2,270	26.0	89.7
1975	2,930	1.7	1,801	–17.5	79.8
1974*	2,880	44.7	2,287	51.5	93.7
1973*	1,990	36.3	1,441	53.1	96.9
1972	1,460	13.2	941	83.8	96.4
1971*	1,290	–25.9	512	–28.8	91.9
1970	1,740	6.9	719	–27.2	91.5

e = Estimate.

* Revised for change in corporate structure of the industry. Percent changes for sales and profits are computed from data (not shown) consistent with previous year.

Sources: 1. Bureau of Economic Analysis; 2. Federal Trade Commission; 3. American Paper Institute (Paper and Paperboard only).

CAPACITY EXPANSION

In its overall dimensions, capacity expansion in the paper industry behaves in classically cyclical fashion, with each grade responding to changes in its own supply/demand equation. During periods of strong demand, production begins to put a strain on supply and prices rise, providing companies with the profits necessary to add more capacity. Complicating the picture are the huge amounts of capital and the long lead times required to bring new tonnage online—two or three years and from $300 to $500 million for a new mill, for example.

Even more volatile cycles have entered the equation in the 1970s and '80s in the form of exchange-rate fluctuations, which can completely turn around a country's competitive position.

With such forces at work, it is not surprising that expansion cycles often get out of hand, especially in commodity grades such as newsprint, market pulp, and linerboard that are affected by capacity changes and trade conditions around the world.

In early 1988, supply was tight for most grades, and both prices and profits were high. As a result, many companies announced expansion programs across a wide spectrum of grades.

Newsprint is in the building stages of a capacity explosion that will hit in the early 1990s, perhaps leading to a period of overcapacity. Kraft linerboard, kraft market pulp, and coated free-sheet paper are all heating up after a period of slow growth.

On the down side of the cycle, the growth in uncoated free-sheet capacity will slacken following a period of heated growth in the mid-1980s, although capacity will continue to grow moderately. Coated groundwood paper expansions will slow down following a period of sustained, strong growth that ended in 1987.

Less-cyclical than other grades, tissue will continue to grow at a moderate pace, while kraft packaging papers will continue in the doldrums due to the competition from plastics.

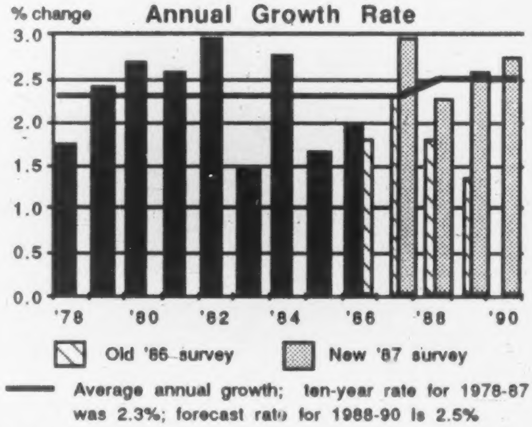
EXPANSION OUTLOOK THROUGH 1990

U.S. paper and paperboard manufacturers plan to add 6.1 million tpy of new capacity from 1988 through 1990, according to the American Paper Institute's fall 1987 survey of expansion plans. That translates into an average annual growth rate of 2.5%—up from 2.3%/year during the 1978-87 period—and represents the most new capacity since 7.6 million tons were added during the 1966-1968 period.

In 1987 alone, capacity climbed an estimated 3.0% from the previous year, or 2.2 million tons, the largest single-year gain in 14 years.

Paper and paperboard production totaled 74.5 million tons in 1987, up 5.0% from 1986, and earnings soared 52%

FORECAST GROWTH 9% ABOVE AVERAGE



Source: American Paper Institute

GROWTH TRENDS IN U.S. PAPER GRADES[1] CAPACITY

(000 short tons)

	Newsprint	% change	Printing & writing	% change	Packaging & converting	% change	Tissue	% change
1990e	6,636	8.8%	24,393	2.8%	5,702	0.3%	5,955	0.5%
1989e	6,099	1.4	23,727	3.9	5,687	0.4	5,924	2.7
1988e	6,013	1.2	22,832	3.0	5,662	1.3	5,771	2.4
3-year change and avg. annual rate	695	3.8	2,225	3.2	110	0.7	320	1.9
1987e	5,941	2.4	22,168	5.7	5,592	–2.9	5,635	3.0
1986	5,804	0.3	20,980	2.5	5,758	–3.8	5,472	2.4
1985	5,788	–1.1	20,473	2.9	5,985	–1.7	5,345	1.3
1984	5,851	1.3	19,890	6.7	6,088	0.2	5,276	1.7
1983	5,774	2.1	18,633	4.6	6,078	—	5,190	1.3
1982	5,654	3.6	17,809	2.9	6,076	2.8	5,125	1.8
1981	5,457	12.8	17,302	3.0	5,913	–2.6	5,035	1.6
1980	4,836	15.2	16,798	4.6	6,072	0.3	4,954	1.7
1979	4,199	2.3	16,057	3.2	6,053	–1.5	4,870	4.9
1978	4,104	0.9	15,566	3.9	6,146	–1.5	4,644	2.2
10-year change and avg. annual rate	1,837	4.0	6,602	4.0	–554	–1.2	991	2.2

1. Excludes construction paper.
e = Estimate.

Source: American Paper Institute.

GROWTH TRENDS IN U.S. PAPER AND PAPERBOARD[1] CAPACITY

(000 short tons)

	Total paper & board	% change	Total paper	% change	Total paperboard	% change
1990e	84,104	2.8%	42,687	3.0%	41,417	2.5%
1989e	81,847	2.6	41,437	2.9	40,410	2.2
1988e	79,799	2.3	40,278	2.4	39,521	2.2
3-year change and avg. annual rate	6,083	2.5	3,351	2.8	2,732	2.3
1987e	78,021	3.0	39,336	3.5	38,685	2.4
1986	75,777	2.0	38,014	1.2	37,763	2.8
1985	74,301	1.6	37,581	1.3	36,720	2.0
1984	73,098	2.8	37,106	4.0	35,992	1.5
1983	71,126	1.5	35,675	2.9	35,451	0.1
1982	70,086	2.8	34,665	2.8	35,421	2.8
1981	68,172	2.7	33,706	3.2	34,466	2.2
1980	66,368	2.7	32,659	4.7	33,709	0.8
1979	64,615	2.4	31,179	2.4	33,436	2.5
1978	63,091	1.8	30,460	2.1	32,631	1.4
10-year change and avg. annual rate	14,930	2.3	8,876	2.8	6,054	1.9

1. Excludes construction paper and board.
e = Estimate.

Source: American Paper Institute.

to $4.99 billion. Demand has been particularly strong for such grades as newsprint, printing and writing papers, and unbleached kraft linerboard. As a result, capacity expansion plans have risen sharply since 1986, when relatively poor business conditions and uncertainties about tax reform depressed papermakers' expansion plans for the 1987-89 period. The 1987 API survey forecasted a growth rate 9% above the 10-year average pace, while the 1986 survey found growth dropping 14% below average.

Capacity growth over the next three years was expected to be high by historical standards in every sector except market pulp, which began to show signs of heating up in early 1988. Total paper capacity will climb to 39.3 million tpy in 1990, up 3.4 million tons from 1987, or 8.5%. Growth will average 2.8%/year, the same as the ten-year average, the API report indicated. Paperboard capacity will rise 7.1%, or 2.7 million tons, to 38.7 million tpy. Growth will average 2.3%/year, up from 1.9% during the 1978-87 period.

Reported gains for woodpulp were lower than for paper and board, API said. Total pulp capacity was expected to reach 60.8 million tpy in 1990, up 3.6 million tons, or 5.9%. That averages out to 1.9% a year, up from 1.6% annually for the past ten years. The imbalance between pulp and paper and paperboard growth will be offset by the use of more recycled fiber, increased imports, and productivity improvements, API said.

GROWTH TRENDS IN U.S. WOODPULP[1] CAPACITY

(000 short tons)

	Total pulp	% change	Market pulp	% change
1990e	64,408	2.2%	8,444	–0.1%
1989e	63,050	2.0	8,454	0.6
1988e	61,829	1.7	8,400	2.9
3-year change and avg. annual rate	3,594	1.9	279	1.1
1987e	60,814	1.8	8,165	1.6
1986	59,750	1.9	8,039	0.6
1985	58,641	1.6	7,989	6.1
1984	57,742	2.8	7,530	1.6
1983	56,143	0.0	7,414	4.7
1982	56,125	2.2	7,079	1.5
1981	54,891	3.1	6,972	2.5
1980	53,215	3.1	6,801	7.4
1979	51,637	3.7	6,334	10.2
1978	49,788	–0.2	5,746	5.1
1977	49,910	2.4	5,467	1.1
10-year change and avg. annual rate	11,026	2.0	2,419	4.1

1. Excludes pulp for construction paper and board.
e = Estimate.

Source: American Paper Institute.

The market pulp outlook was revised sharply upward in early 1988, as a string of expansion projects was announced. Mill operators originally expected to add only 3.4% to capacity by 1990, or 279,000 tons. That works out to average growth of 1.1%/year, compared with 4.1%/year during the massive buildup of the past ten years. However, new projects will add an additional 450,000 tpy by 1990 for an overall increase of 8.9%..

Market crash ignored—for now. Investment plans were basically unaffected by the October 1987 stock-market crash, but if the economy sours in coming months, paper companies are well positioned to cut back on expansion plans. Except for a few large projects, plans for 1989 and 1990 (when the bulk of current growth is scheduled) are still on the drawing board, where they can be postponed if the economy turns down.

Newsprint will post the most dramatic increase in growth among the paper grades, rising 11.7% by 1990, or 695,000 tpy, after eight years of inactivity. New mills under construction by Newsprint South Inc. and Ponderay Newsprint Co. as well as a new machine to be built by Southeast Paper Mfg. Co. are responsible for most of the increase. All three projects were approved during 1987 for startup in 1989. In early 1988, Abitibi-Price Inc. and Parsons & Whittemore Inc. announced plans to build a joint-venture newsprint mill at Claiborne, Ala., for startup in 1990, adding another 242,500 tpy to U.S. capacity.

The printing and writing grades present a mixed picture, as mills report higher-than-average plans for coated free-sheet and uncoated groundwood but slower growth for uncoated free-sheet and coated groundwood. The largest of these grades, uncoated free-sheet, is expected to add one million tons by 1990, or 8.9%. That translates into a growth rate of 2.9%/year, higher than the average paper grade but well off its 10-year pace of 4.4%/year.

Two major projects account for almost 500,000 tons of this new uncoated free-sheet capacity: a 200,000-tpy expansion planned by International Paper Co. for an unspecified location in the South and scheduled for completion in 1989 and a new 294,000-tpy paper machine starting up in 1988 at Georgia-Pacific Corp.'s Port Hudson, La., mill. After the survey, Willamette Industries Inc. announced it would build a new uncoated free-sheet mill at Bennetsville, S.C., adding 200,000 tpy to the total for 1990.

Coated free-sheet papers will post a growth rate of 19.9%, the highest of any grade. About 643,000 tons will be added by 1990, with average growth of 6.3%/year, up from 5.1%/year over the past ten years. Projects include new paper machines for Midtec Paper Corp. and Potlatch Corp. starting up in 1988, as well as smaller expansions. Capacity swings have added to free-sheet capacity at the expense of coated groundwood, which is one of the few grades where capacity expansion plans are lower than in 1986. The only major plan for coated groundwood expansion is Blandin Paper Co.'s new machine at Grand Rapids, Minn., which will add a net 254,000 tpy to capacity in 1989.

On the uncoated groundwood side, Lake Superior Paper

GROWTH TRENDS IN U.S. PAPERBOARD GRADES[1] CAPACITY

(000 short tons)

	Unbleached kraft	% change	Solid bleached	% change	Semi-chemical	% change	Recycled	% change
1990e	21,088	4.4%	4,866	0.2%	5,934	1.2%	9,529	0.3%
1989e	20,193	3.0	4,854	1.8	5,863	2.7	9,500	0.6
1988e	19,596	2.5	4,768	2.0	5,711	1.2	9,446	2.1
3-year change and avg. annual rate	1,971	3.3	191	1.3	293	1.7	277	1.0
1987e	19,117	2.4	4,675	2.2	5,641	1.5	9,252	2.7
1986	18,662	2.9	4,576	4.7	5,557	2.7	9,008	2.4
1985	18,144	1.7	4,370	4.4	5,411	3.0	8,795	0.8
1984	17,834	1.8	4,185	1.4	5,252	2.6	8,722	0.3
1983	17,511	0.6	4,129	0.1	5,119	–1.7	8,962	—
1982	17,402	4.0	4,123	–0.4	5,207	4.4	8,690	1.1
1981	16,738	4.8	4,141	–0.9	4,988	0.8	8,599	–0.2
1980	15,967	2.7	4,180	–2.1	4,946	1.7	8,617	–1.6
1979	15,546	3.3	4,268	1.7	4,864	2.6	8,757	1.3
1978	15,054	1.8	4,197	4.4	4,739	1.7	8,642	–0.7
10-year change and avg. annual rate	4,063	2.6	478	1.5	902	1.9	610	0.7

1. Excludes construction board.
e = Estimate.
Source: American Paper Institute.

GROWTH TRENDS IN U.S. PULP GRADES[1] CAPACITY

(000 short tons)

	Dissolving & special alpha	% change	Sulfite	% change	Sulfate, soda, and screenings	% change	Semi-chemical	% change	Mechanical	% change
1990e	1,396	0.1%	1,572	0.0%	49,663	1.9%	4,746	0.7%	7,023	6.0%
1989e	1,395	0.0	1,572	0.0	48,740	2.1	4,712	1.6	6,623	2.2
1988e	1,395	0.9	1,572	–2.7	47,737	1.9	4,639	0.3	6,478	2.3
3-year change and average annual rate	14	0.3	–44	–0.9	2,812	2.0	119	0.9	692	3.5
1987e	1,382	–1.2	1,616	–5.1	46,851	2.0	4,627	–0.1	6,331	4.5
1986	1,399	–3.8	1,703	–2.0	45,952	2.5	4,631	–0.4	6,058	1.6
1985	1,454	–2.2	1,738	19.9	44,835	2.5	4,650	0.5	5,964	–2.6
1984	1,487	–2.5	1,450	–18.9	43,758	2.9	4,625	3.0	6,122	5.3
1983	1,525	–5.0	1,788	0.4	42,526	0.7	4,490	–5.2	5,814	0.6
1982	1,606	0.5	1,780	–4.0	42,225	2.1	4,734	3.0	5,780	5.2
1981	1,598	0.5	1,855	–2.8	41,346	3.3	4,597	–0.1	5,494	8.4
1980	1,590	2.5	1,909	–4.7	40,044	2.8	4,601	1.1	5,070	10.9
1979	1,551	–1.4	2,004	–4.3	38,956	2.6	4,553	–0.4	4,573	–0.2
1978	1,573	–4.6	2,095	–7.0	37,968	2.6	4,572	1.3	4,580	1.7
10-year change and average annual rate	–191	–1.7	–479	–2.9	8,883	2.4	55	0.3	1,751	3.5

1. Excludes pulp for construction paper and board.
e = Estimate.
Source: American Paper Institute.

Industries started up a new 235,000-tpy supercalendered paper mill in Duluth, Minn., in early 1988. This is the only major U.S. expansion currently set for this grade, although Daishowa Paper Mfg. Co. Ltd. of Japan has indicated that it is studying a new 150,000-tpy uncoated groundwood paper machine for its recently purchased Daishowa America Co. Inc. mill at Port Angeles, Wash.

Tissue capacity is expected to grow 320,000 tpy by 1990, or 1.9% a year on average. Fort Howard Corp. started up a new recycled tissue mill with one 82,500-tpy machine in 1987, and a second unit of similar size came online in early 1988. The mill will eventually have four machines. James River Corp. will start up a new 70,000-tpy tissue machine at Wauna, Ore., in 1988, and the company plans to install two additional machines at unspecified locations during the 1989-94 period. Kimberly-Clark Corp. announced in early 1988 that it would build a new 68,000-tpy tissue mill at Jenks, Okla., for startup in 1990.

Paperboard. Unbleached kraft paperboard will show the largest gain among the paperboard grades, adding nearly two million tons during the period, or 10.3%. Linerboard accounts for about 1.5 million tons of this total, and Mead Corp.'s folding boxboard mill, to be built at Mahrt, Ala., by 1990, accounts for most of the remaining 500,000 tons. Gaylord Container Ltd.'s new 350,000-tpy paper machine, under construction at Bogalusa, La., for startup in 1989, is the largest single linerboard project included in the survey. After the survey, Union Camp Corp. announced a new machine for Savannah, Ga., that will add an additional 460,000 tpy to capacity in 1991.

Because of depressed prices in the mid-1980s, the Gaylord machine is the first new linerboard producer to be built since 1985. During this period, incremental capacity expansion has been much more important. In the next three

REGIONAL CAPACITY DISTRIBUTION

(000 short tons)

	1990e	1985	1980	1975
TOTAL PAPER/BOARD*				
New England	6,341	6,133	5,536	5,106
Mid-Atlantic	5,601	5,307	5,801	5,760
East North Central	12,923	11,937	10,440	10,110
West North Central	1,999	1,536	1,290	1,193
South Atlantic	20,703	17,090	16,455	14,396
East South Central	11,099	9,799	8,152	7,380
West South Central	12,677	10,759	9,632	8,487
Mountain & Pacific	12,064	10,920	9,364	8,423
Total U.S.	83,407	74,301	66,670	60,855
TOTAL WOODPULP*				
New England	3,436	3,393	3,123	2,736
Mid-Atlantic	1,390	1,376	1,315	1,285
East North Central	4,085	3,411	3,188	2,906
West North Central	914	629	577	685
South Atlantic	20,347	18,724	16,902	15,220
East South Central	11,518	10,891	9,062	7,675
West South Central	11,308	10,226	9,821	8,971
Mountain & Pacific	10,832	9,990	9,228	8,861
Total U.S.	63,830	58,640	53,216	48,339

Regions are as follows:

New England: Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island.
Mid-Atlantic: New York, Pennsylvania, New Jersey.
East North Central: Wisconsin, Michigan, Illinois, Indiana, Ohio.
West North Central: North Dakota, South Dakota, Minnesota, Nebraska, Iowa, Kansas, Missouri.
South Atlantic: Delaware, Maryland, West Virginia, Virginia, North Carolina, South Carolina, Georgia, Florida.
East South Central: Kentucky, Tennessee, Mississippi, Alabama.
West South Central: Oklahoma, Arkansas, Texas, Louisiana.
Mountain/Pacific: Washington, Oregon, California, Nevada, Idaho, Montana, Wyoming, Utah, Arizona, New Mexico.

* Excludes construction paper and board and pulp to produce these grades.
e = Estimate.

Source: American Paper Institute.

NEW MILLS AND PAPER MACHINES ANNOUNCED FOR U.S.

Company	Location	Project	Grade	Capacity (tpy)
Started up in 1986				
Bowater Carolina	Catawba, S.C.	new machine	coated groundwood	197,000
Consolidated Paper	Wisconsin Rapids, Wis.	new machine	coated groundwood	180,000
Georgia-Pacific	Zachary, La.	new machine	uncoated free-sheet	230,000
Hammermill Paper	Selma, Ala.	new machine	uncoated free-sheet	185,000
International Paper	Pine Bluff, Ark.	new machine	coated groundwood	200,000*
James River	Pennington, Ala.	new machine	tissue	70,000
Kimberly-Clark	Whiting, Wis.	new machine	cotton fiber paper	29,000
Scott/S.D. Warren	Skowhegan, Maine	new machine	coated free-sheet	215,000
Westvaco	Covington, Va.	new machine	bleached paperboard	175,000
Started up in 1987				
Fort Howard	Rincon, Ga.	new mill	tissue	88,000
Linweave Fine Papers	Holyoke, Mass.	new machine	fine paper	25,000
For 1988 startup				
Fort Howard	Rincon, Ga.	new machine	tissue	88,000
Georgia-Pacific	Palatka, Fla.	new machine	tissue	35,000 net
Georgia-Pacific	Zachary, La.	new machine	uncoated free-sheet	294,000
James River	Wauna, Ore.	new machine	tissue	70,000
Midtec Paper	Kimberly, Wis.	new machine	coated free-sheet	205,000*
Pentair	Duluth, Minn.	new mill	SC groundwood	235,000
Potlatch	Cloquet, Minn.	new machine	coated free-sheet	n.a.
For 1989 startup				
Blandin Paper	Grand Rapids, Minn.	new machine	coated groundwood	254,000*
Chesapeake	Menasha, Wis.	new machine	tissue	80,000
Fort Howard	Green Bay, Wis.	new machine	tissue	n.a.
Gaylord Container	Bogalusa, La.	new machine	unbleached kraft liner	354,000
International Paper	U.S. South	new machine	uncoated free-sheet	200,000
Kimberly-Clark	Whiting, Wis.	new machine	cotton fiber paper	30,000
Newsprint South	Grenada, Miss.	new mill	newsprint	225,000
Ponderay Newsprint	Usk, Wash.	new mill	newsprint	198,000
For 1990 startup				
Champion International	Quinnesec, Mich.	new machine	coated free-sheet	265,000
Kimberly-Clark	Jenks, Okla.	new mill	tissue	68,000
Mead	Mahrt, Ala.	new mill	coated kraft paperboard	350,000
Southeast Paper	Dublin, Ga.	new machine	newsprint	210,000
Willamette	Bennetsville, S.C.	new mill	uncoated free-sheet	200,000
For 1991 startup				
Union Camp	Savannah, Ga.	new machine	unbleached kraft liner	460,000*
Proposed projects (no startup date announced)				
Atlas Paper Mills	Hialeah, Fla.	new machine	tissue	n.a.
Bear Island Paper	Ashland, Va.	new machine	newsprint	225,000
Daishowa America	Port Angeles, Wash.	new machine	newsprint	200,000
Daishowa America	Port Angeles, Wash.	new machine	uncoated groundwood	150,000
Fort Howard	Rincon, Ga.	new machines (2)	tissue	160,000
International Paper	Undetermined	new machine	coated free-sheet	175,000
James River	Unspecified	new machines (2)	tissue	n.a.
Kenaf International	South Texas	new mill	newsprint	237,000
Mi Ho Paper	St. Joseph, Mo.	new mill	recycled boxboard	n.a.
Smurfit Newsprint	Newberg, Ore.	new machine	newsprint	275,000
Westvaco	Wickliffe, Ky.	new machine	free-sheet	n.a.

n.a. = Not available.

* Replaces some existing capacity.

Source: *Pulp & Paper Project Report.*

years, API reports, 14 linerboard machines are scheduled for major rebuilds, each adding 50,000 tpy or more.

Recycled paperboard will show a relatively strong gain of 277,000 tons, up 1.0%/year vs 0.6%/year over the past ten years. Bleached paperboard capacity will climb just 1.3%/year, adding 191,000 tons by 1990. No new paper machines are scheduled for the period, but one proposal is currently under consideration—a new unit for Federal Paper Board Co. Inc.'s Augusta, Ga., mill that was temporarily postponed after the stock-market crash.

Pulp growth picking up. Activity is picking up strongly in the chemical pulping area after a hiatus of several years. High pulp prices and tight markets are an incentive to both producers, who need more pulp to sell, and consumers, who want to quit buying expensive market pulp. The current crop of expansion projects is about evenly divided between the two groups.

This upswing in expansion plans has been a recent phenomenon, with eight of the largest projects gaining approval within the first few months of 1988. Since fall 1987, the market pulp outlook for the early 1990s has changed dramatically. Expansion projects announced for completion in 1990 by Weyerhaeuser Co. at Columbus, Miss.; Louisiana-Pacific Corp. at Samoa, Calif.; and Bowater Southern Paper Co. at Calhoun, Tenn., will add over 450,000 tpy to bleached kraft market pulp capacity.

INDEFINITELY IDLED PULP AND PAPER MILLS IN U.S.

Company	Mill	Grade
Allied Materials	Stroud, Okla.	Roofing felt
Bear Brand Roofing	Bearden, Ark.	Roofing felt
Boise Cascade	Elizabeth, La.	Kraft paper
Boise Cascade*	Salem, Ore.	Uncoated free-sheet
Caribbean Forest Products	Arecibo, P.R.	Containerboard
Celotex	Dubuque, Iowa	Insulation board
Celotex	Perth Amboy, N.J.	Roofing felt
Celotex	Cincinnati, Ohio	Roofing felt
Celotex	Paris, Tenn.	Hardboard
Clevepak	Piermont, N.Y.	Recycled paperboard
Cottrell Paper	Fort Edward, N.Y.	Rag pulp
Crown Paper Board	Philadelphia, Pa.	Recycled paperboard
Deerfield Specialty Papers	Monroe Bridge, Mass.	Specialty papers
Doeskin	Clayville, N.Y.	Tissue
Elk	Stephens, Ark.	Roofing felt
Falls Tissue	Mechanic Falls, Maine	Tissue
Federal Paper Board	Marseilles, Ill.	Recycled paperboard
Georgia-Pacific	Thomson, N.Y.	Not in mill section
Hinsdale Products	Hinsdale, N.H.	Tissue
International Paper	Bastrop, La.	Semichemical medium
International Paper	Springhill, La.	Kraft paper/board
International Paper	Reigelsville, Pa.	Recycled paperboard
James River, Riegel Div.	Riegelsville, N.J.	Specialty papers
Manville	Manville, N.J.	Roofing felt
Pacific Coast Packaging	Los Angeles, Calif.	Recycled paperboard
Packaging Corp. of America	Middletown, Ohio	Molded pulp
Pennsylvania General	Buck Run, Pa.	Tissue
Ponderosa St. Lawrence	Ogdensburg, N.Y.	Deinked market pulp
Reading-Whitehall	Whitehall, Md.	Recycled paperboard
Simkins Industries	Miami, Fla.	Recycled paperboard
Skybel Tissue Mills	Greenwich, N.Y.	Tissue
Sonoco Products	Richmond, Calif.	Recycled paperboard
3M	Hartford City, Ind.	Carbonless paper
TLR	Bellows Falls, Vt.	Specialty papers
United States Gypsum	Oakmont, Pa.	Kraft paper
Vincennes Paper Mills	Vincennes, Ind.	Recycled paperboard
Warrensburg Board & Paper	Warrensburg, N.Y.	Corrugating medium
Whippany Paper Board	Clifton, N.J.	Recycled paperboard
Whippany Paper Board	Whippany, N.J.	Recycled paperboard

* Mill has been dismantled.

Source: *1988 Lockwood-Post's Directory.*

These new projects join previously announced major expansions underway at Georgia-Pacific's Port Hudson, La., mill; Nekoosa Papers Inc.'s Ashdown, Ark., facility; Federal Paper Board's Riegelsville, N.C., mill; and ITT Rayonier Inc.'s Jesup, Ga., plant.

The Weyerhaeuser-Columbus and Bowater-Calhoun projects will provide pulp for both internal consumption and for market sale. About 200 tpd of the 1,200-tpd Weyerhaeuser expansion will go for internal use. At Bowater, the new 900-tpd bleached kraft pulp facility will replace an aging 700-tpd semichemical kraft pulp plant, providing low-cost furnish for newsprint production as well as about 80,000 tpy of hardwood kraft pulp to sell on the open market. In a similar vein, the new newsprint mill to be built by Abitibi-Price and Parsons & Whittemore at Claiborne, Ala., will benefit from pulp supplied by P&W's adjacent Alabama River pulp mill, which plans to boost pulp capacity about 30,000 tpy.

Among integrated papermakers, the kraft paperboard sector is contributing the most to pulp expansion activity, with plans to overhaul aging facilities to control odor and reduce costs and to provide furnish for new capacity.

Union Camp is the leader in this regard, with two projects underway to modernize pulp facilities in support of linerboard expansions at Montgomery, Ala., and Savannah, Ga. Major programs are also under way at Federal Paper Board's Augusta, Ga., bleached paperboard mill and at Temple-Inland Inc.'s Rome, Ga., linerboard facility.

PAPER AND PAPERBOARD CAPACITY REDUCTIONS

	Number of paper machines shut down*				Number of paper mills shut down*			
	1971-75	1976-80	1981-84	1985-90e	1971-75	1976-80	1981-84	1985-90e
PAPER								
Newsprint	—	3	3	2	—	1	—	—
Printing and writing	51	32	23	28	8	5	2	2
Packaging/ind. converting	35	32	22	14	8	7	6	1
Tissue	6	25	26	6	4	8	11	2
PAPERBOARD								
Unbleached kraft	2	2	4	3	—	1	—	—
Solid bleached	1	2	—	1	—	1	—	—
Semichemical	3	4	6	2	1	1	1	1
Recycled	29	35	18	2	14	12	12	—
TOTAL PAPER AND BOARD	127	135	102	58	35	36	32	6
Average rate/year	21	34	26	10	9	5	11	3

* Includes machines converted to other grades.

Source: American Paper Institute.

PAPER AND PAPERBOARD CAPACITY REDUCTIONS

(000 short tpy)

	1971-75	1976-80	1981-84	1985-90e
PAPER				
Newsprint	—	231	206	154
Printing and writing	803	550	517	583
Packaging/ind. converting	290	395	360	758
Tissue	52	246	264	57
PAPERBOARD				
Unbleached kraft	128	400	562	565
Solid bleached	33	162	—	95
Semichemical	123	178	463	190
Recycled	872	1,295	644	30
TOTAL PAPER AND BOARD	2,301	3,457	3,016	2,432
Average rate/year	460	691	603	486

Source: American Paper Institute.

MERGERS AND ACQUISITIONS

Merger and acquisition activity in the paper industry has skyrocketed in the 1980s, mirroring a trend that is evident throughout the U.S. business world. Counting just major purchases where dollar amounts are publicly available, merger and acquisition costs involving industry assets approached $25 billion for the ten-year period from 1978 to 1987 (see table in this chapter for a list of recent sales). Smaller deals and those where prices were not announced should easily add 5% to 10% to that total.

The size of acquisitions as well as the volume is growing. According to First Boston analysts, the average value of transactions in the mid-1980s was about $600 million, and there have been 20 deals in the $100-million range. Through 1987, there were five multi-billion-dollar deals for paper companies, beginning with Champion International Corp.'s buyout of St. Regis Corp. in 1984 for $1.84 billion. Another three deals involving industry assets have been made for companies peripheral to the industry. In mid-1988, a $3.57 billion offer was made for Fort Howard Corp., which if approved would set a new high for industry acquisitions.

The merger boom of the 1980s has clearly left its mark on the structure of the industry. Fourteen of 32 Fortune 500 companies in the forest-products industry have made large purchases recently. Three in this group—Bowater Inc., Temple-Inland Inc., and Georgia Kraft Co.—are recent spin-offs from larger companies. Between 1983 and 1987, nine of the top industry producers (those with capacity for 1,000 tpd or more) disappeared, all of them swallowed up by other companies. This group included Container Corp. of America, Continental Forest Industries, Crown Zellerbach Corp., Hammermill Paper Co., Jacksonville Kraft Co., Owens-Illinois Forest Products, Publishers Paper Co., St. Regis Corp., and Southwest Forest Industries Inc.

Among the top ten producers, only Scott Paper Co. has not made a major purchase in recent years. Stone Container Corp., James River Corp., and Jefferson Smurfit Corp. have been the most aggressive at growing through acquisitions. Others that have grown substantially through purchases include Champion, International Paper Co., Great Northern Nekoosa Corp., Georgia-Pacific Corp., and Federal Paper Board Co. Inc.

Acquisitions have also accelerated the industry's long-term trend toward higher concentration. A third or more of the linerboard industry's capacity changed hands in the mid-1980s alone. In 1987, the top five companies held 45% of kraft linerboard capacity, and the top ten 71%. Overall, concentration among the top 15 paper and paperboard producers grew from 53% in 1983 to 68% in 1987. The top 15 pulp producers increased their share from 56% to 70% over the same period.

Why have the mid-1980s been such boom years for mergers and acquisitions? One important factor is the threat of takeover, which has forced company managements to concentrate on shareholder value like never before. Related to this is the trend toward de-conglomeration, in which diversified companies sell off assets outside their main business lines.

Another factor is the build-vs-buy equation. In the 1980s, it has usually been much cheaper to buy an existing mill than to build one. First Boston estimates that recent major transactions have been for just 30% to 40% of replacement value.

The takeover threat. Three factors have helped make the takeover threat real for the paper industry: undervalued companies ripe for the picking, the ready availability of funds to make purchases, and a lax antitrust environment that offers few obstacles to dealmaking.

Corporate raiders have been attracted to the paper industry by its undervalued assets, particularly to diversified companies that can be broken up and sold in pieces. The paper industry is a capital-intensive, cyclical business that has usually offered below-average returns to investors. In 1987, forest products led the Fortune 500 in sales and earnings growth, yet it ranked ninth in return to stockholders. On average, the industry ranks 13th in total return for the past ten years. Consequently, companies often find themselves in a vulnerable position where their stock prices do not even cover the value of their assets.

What has made the takeover threat so real is the ready availability of funds, even for multi-billion dollar deals. Whole new financial industries have sprung up around the leveraged buyout (LBO) and junk bonds, and more traditional bank loans and equity financing opportunities have also grown tremendously. Sheer size, which used to protect companies from unwanted suitors, is no longer an adequate defense. This situation has forced companies to take a hard look at their operations, to concentrate their assets in the businesses they know best, or to purchase complementary businesses that can help boost returns.

Favorable business climate. The merger boom also got a boost from the lax antitrust environment of the Reagan years. In the highly concentrated tissue sector, James River has become number two through a series of acquisitions beginning in 1982. Stone Container has grown to its number one position in kraft linerboard over the same period. International Paper was able to purchase competitor Hammermill in 1986, adding to its already commanding presence in white papers.

The tax code has favored takeovers for most of the 1980s as well. Before 1987, low capital gains rates and other incentives made acquisitions attractive for raiders who wanted to sell off assets quickly. Merger activity grew to a frenzy in 1986, as companies struggled to complete deals before the Tax Reform Act took effect. A similar situation developed in 1987, with companies trying to beat tax legislation designed to close loopholes in the 1986 bill.

The outlook for 1988. The combination of excellent operating conditions, readily available funds, and low stock prices should keep acquisition activity high in 1988. Uncertainty about antitrust regulation in 1989 and beyond could also give a lift to dealmaking this year. Given the backlash against corporate raiders and changes in the tax code, the merger and acquisition market in 1988 will probably favor deals where the purchaser is looking for a good business fit, rather than assets that can be broken up and sold off quickly. One trend to watch for, however, is hostile takeover attempts from within the industry.

The October 1987 stock market crash has served to lower prices for paper company stocks and to attract huge amounts of cash to LBO funds—a combination that could lead to some earthshaking deals in 1988. One such mega-deal was proposed at mid-year, when company management and a Morgan Stanley LBO fund offered $3.57 billion to take Fort Howard Corp. private. Rumors have swirled around other major companies such as Stone Container, Kimberly-Clark Corp., and Louisiana-Pacific Corp.

Takeover prices may or may not be rising this year. In 1987, Great Northern Nekoosa paid a price near replacement cost for Owens-Illinois' Forest Products Group, leading many observers to suggest that takeover prices were on the rise. Also in 1987, Mead and Scott were forced to withdraw a proposal to sell Brunswick Pulp & Paper when they could not find a buyer at the asking price. In June 1988, however, Brunswick was sold to Georgia-Pacific for just $665 million, substantially below replacement cost.

HOSTILE TAKEOVER ATTEMPTS

Corporate raiders are less of a threat now than they were a few years ago. Most companies have taken steps to prevent hostile takeovers, such as selling off assets that might attract raiders, restructuring debt, enacting "poison pills," and staggering directorships. USG Industries successfully fought off a hostile takeover attempt by Desert Partners in 1988 by pushing through its own recapitalization plan, for example.

The 1986 and 1987 tax reform laws also made it more difficult for raiders to realize a quick profit on their deals. In addition, raiders have suffered adverse publicity from insider-trading scandals, and many states have passed laws limiting hostile takeovers.

In the early and mid-1980s, however, raiders made a lot of money toppling U.S. paper companies, whether through successful buyouts, "greenmail," or sale of their shares to a higher bidder.

Hostile takeover attempts have come almost exclusively from raiders outside the industry. While aggressive companies like James River Corp. and Stone Container Corp. have been quick to buy assets put up for sale once companies have been taken over, they have not initiated hostilities themselves. Jefferson Smurfit purchased a stake in Southwest Forest Industries in 1984, after a management-led leveraged buyout of SFI failed, but merger talks broke down quickly and Smurfit later agreed not to purchase SFI stock for ten years. In early 1986, SFI had to fend off another takeover attempt, this time from a group of Oklahoma oil and gas investors. SFI was finally purchased in 1987 in a friendly merger with Stone Container worth $760 million.

Goldsmith heads list of raiders. British financier James Goldsmith has been the most aggressive suitor of U.S. paper companies, making unsolicited offers for Diamond International Corp., Continental Group Inc., St. Regis, and Crown Zellerbach. All four companies lost their independence, two to Goldsmith and two to "white-knight" purchasers.

Goldsmith's strategy was to seek out undervalued companies with assets that could be sold off easily as independent units. Accumulating stock gradually after buying an initial 5.6% stake in late 1979, Goldsmith completed the acquisition of Diamond International in 1982. Total purchase price over the three-year period was about $660 million. Goldsmith then began selling off Diamond's assets a division at a time, grossing roughly $850 million from the sales by 1983. Diamond's paperboard, converting, and printing businesses were sold to Jefferson Smurfit for $80 million in 1982. In 1983, James River bought the company's papermaking assets for $170 million.

Goldsmith's next industry target was Continental Group, an insurance, energy, and packaging company and the

MAJOR ACQUISITIONS INVOLVING U.S. PULP AND PAPER MILL ASSETS

Acquiring company	Assets purchased	Estimated value (million $)	Year effective
Daishowa America Co. Ltd.	Port Angeles, Wash., groundwood paper mill from James River	75	1988
Gaylord Container Corp.	Fibreboard Corp. containerboard assets from Louisiana-Pacific	156	1988
James River Corp.	50% interest in Kaysersberg Div. of French papermaker Beghin-Say; to be carried out in stages through 1989	243	1988
Kapaco Group	Pentair's Detroit, Mich., specialty paper mill	n.a.	1988
Rock-Tenn Co.	Mead's recycled paperboard businesses	n.a.	1988
Eddy Forest Products Ltd.	Port Huron Paper Corp. from Pentair	n.a.	1987
P.H. Glatfelter Co.	Ecusta Corp.	219	1987
Great Northern Nekoosa Corp.	Forest Products Group of Owens-Illinois	1,150	1987
James River Corp.	Dunn Paper Co. from Dennison Manufacturing	n.a.	1987
Kohlberg Kravis Roberts & Co.	Jim Walters Corp.	2,440	1987
Kohlberg Kravis Roberts & Co.	Owens-Illinois Inc.	3,660	1987
Mead Corp.	Georgia Kraft Co. mill in Phenix City, Ala.; part of reorganization and termination of joint venture with Temple-Inland	n.a.	1987
Mohawk Paper Mills	40% of Newton Falls Paper Mill from Stora Kopparberg	7	1987
Pope & Talbot Inc.	Ranson, Pa., tissue mill from Potlatch	27	1987
Pratt Holdings Pty Ltd.	Georgia Kraft Co. linerboard mill and related assets in Macon, Ga.	272	1987
Simkins Industries Inc.	Deerfield Specialty Papers from Reed Holdings Inc.	n.a.	1987
Simpson Paper Co.	Pasadena, Texas, free-sheet paper mill of Champion International	n.a.	1987
Simpson Paper Co.	Plainwell Paper Co. from Chesapeake Corp.	n.a.	1987
Smorgon Consolidated Industries Pty Ltd.	FSC Paper Corp. from Media General and Interstate Holdings	n.a.	1987
Stone Container Corp.	Southwest Forest Industries	760	1987
Stora Kopparberg Group	40% of Mohawk Paper Mills	24	1987
Temple-Inland Inc.	Georgia Kraft Co. mill in Rome, Ga.; part of termination of joint venture with Mead	n.a.	1987
Boise Cascade Corp.	Jackson, Ala., mill of Allied Paper Inc.	150	1986
China National Packaging Corp.	Morris Paper Board mill in Paterson, N.J.	n.a.	1986
GC Acquisition Corp.	Gaylord Container Corp., spun off during James River's acquisition of Crown Zellerbach	260	1986
Hanson Trust plc	Allied Paper Inc. from SCM Corp.	n.a.	1986
International Paper Co.	Hammermill Paper Co.	1,100	1986
JFC-MS Holdings Inc.	Container Corp. of America from Mobil Corp.	1,160	1986
James River Corp.	Crown Zellerbach Corp. pulp and paper operations	1,600	1986
James River Corp.	Premoid Group from Preco Corp.	n.a.	1986
Lydall Inc.	Manning Paper Div. mill of Hammermill Paper at Green Island, N.Y.	n.a.	1986
Mid-America Packaging Inc.	Unbleached kraft paper mill and bag plant at Pine Bluff, Ark., from Weyerhaeuser	n.a.	1986
Rand-Whitney Packaging Corp.	Montville, Conn., boxboard mill from Robertson Paper Box	n.a.	1986
Seminole Kraft Corp.	Jacksonville Kraft Paper Co.	67	1986
Jefferson Smurfit Corp.	80% of Publishers Paper Co. from Times Mirror Inc.; included two newsprint mills	150	1986
Stone Container Corp.	Most of the packaging operations of Champion International	426	1986
Temple-Inland Inc.	Linerboard mill at Orange, Texas, from Owens-Illinois	228	1986
Texcrom Paper Corp.	Chambersburg, Pa., tissue mill from United Paper Mills	n.a.	1986

continued

MAJOR ACQUISITIONS INVOLVING U.S. PULP AND PAPER MILL ASSETS (continued)

Acquiring company	Assets purchased	Estimated value (million $)	Year effective
Carlyle Investments	Hennepin Paper Co. from Champion International, and Pejepscot Paper Co., from Hearst Corp.	n.a.	1985
Chesapeake Corp.	Wisconsin Tissue Mills and Plainwell Paper from Philip Morris Inc.	210	1985
Crystal Tissue Co.	Company taken private	n.a.	1985
Ecusta Corp.	Purchased in leveraged buyout from Olin Corp.	130	1985
Hammermill Paper Co.	Nicolet Paper Co. from Philip Morris Inc.	n.a.	1985
International Paper Co.	Durham Mills recycled paperboard mill at Reigelsville, Pa.	n.a.	1985
Lyons Falls Pulp & Paper Inc.	Lyons Falls, N.Y., mill of Georgia-Pacific	n.a.	1985
Petratex Paper Co. Inc.	Specialty kraft paper mill of Bemis Co. at Peoria, Ill.	n.a.	1985
Simpson Paper Co.	Tacoma, Wash., kraft paper mill of Champion International	n.a.	1985
Trident Associates	Two recycled paperboard mills and six folding carton plants from Champion International	n.a.	1985
Appleton Papers Inc.	Glatfelter's West Carrollton, Ohio, mill	83	1984
Ashuelot Paper Co.	Putney Paper Co.	n.a.	1984
Boise Cascade Corp.	Sonat's 50% interest in Boise Southern	217	1984
Bowater Inc.	Bowater Corp.'s North American assets	123	1984
Caraustar Industries Inc.	Three CCA recycled paperboard mills	n.a.	1984
Champion International Corp.	St. Regis Corp.	1,840	1984
Domtar Inc.	Upson Co.	n.a.	1984
Georgia-Pacific Corp.	Monticello, Miss., linerboard mill and related assets, from St. Regis	343	1984
Peter Kiewit Sons/ Murdock Investment	Continental Group Inc.	2,785	1984
Little Rapids Corp.	Potsdam Paper Corp.	n.a.	1984
Rock-Tenn Co.	Stroudsburg Paperboard Co.	n.a.	1984
Shoreham Packaging Group	Watervliet Paper Co.	n.a.	1984
Stora Kopparberg Group	Newton Falls Paper Mill	n.a.	1984
Temple-Inland Inc.	Temple-Eastex and Inland Container, spun-off by Time Inc.	n.a.	1984
United States Gypsum Co.	Masonite Corp.	204+	1984
Boise Cascade Corp.	Saxon's Missisquoi specialty paperboard mill	n.a.	1983
Haindl Paper Co.	Crown Zellerbach's Port Townsend, Wash., unbleached kraft paper mill	n.a.	1983
Jacksonville Paper Co.	St. Regis kraft paper mill	n.a.	1983
James River Corp.	American Can's Marathon, Ont., pulp mill	n.a.	1983
James River Corp.	Diamond International's pulp and papermaking assets	171	1983
James River Corp.	H.P. Smith Paper from Philips Petroleum	35	1983
Mosinee Paper Corp.	Sorg Paper Co.	18	1983
Palmyra Paperboard Co.	Simplex chipboard mill	n.a.	1983
Pentair Inc.	Port Huron Paper Co.	15	1983
Pope & Talbot Inc.	American Can's 50% interest in Halsey, Ore., pulp mill	14	1983
Republic Gypsum Co.	Two PCA recycled boxboard mills	n.a.	1983
Rock-Tenn Co.	Clevepak's partition mill division, recycled board mill, folding carton plant	40	1983
Scott Paper Co.	50% not already owned of Italian affiliate Burgo Scott	28	1983
Simpson Paper Co.	Harding-Jones Paper Co.	n.a.	1983
Stone Container Corp.	Major portion of Continental Forest's Brown System	510	1983
Stroudsburg Paperboard Co.	Clay-coated board mill from PCA	n.a.	1983
Technographics Inc.	Litton Industries, including Fitchburg Paper	70	1983

largest U.S. producer of bleached paperboard. After purchasing a 1% stake in Continental for about $15 million, Goldsmith offered $50/share for the remainder of the company, or about $2.42 billion. Continental's management rejected the offer, however, and soon afterward agreed to a merger with a company owned 80% by Peter Kiewit Sons and 20% by financier David Murdock's Murdock Investment Corp. That deal was worth $58.50/share or about $2.79 billion.

To help finance the acquisition, Kiewit-Murdock sold Continental's big bleached paperboard mill at Augusta, Ga., and related assets to Federal Paper Board Co. Inc. in early 1985 for $305 million.

Fight for St. Regis. St. Regis Corp. suffered at the hands of raiders, including Goldsmith, for most of 1984. Between February and September, the company fought off two unsolicited takeover attempts, sold a large chunk of its containerboard assets in a bid to reduce its vulnerability, agreed to buy an insurance company for the same reason, and finally agreed to be acquired by white knight Champion International.

Following the same pattern as the Diamond takeover, an investor group led by Goldsmith bought an 8.6% stake in St. Regis in February. The group intended to gradually increase its stake and eventually take over the company, but St. Regis bought back its shares from the group in March, paying a substantial premium over its then-current stock price—a defensive payoff known as "greenmail."

In May, St. Regis sold its Monticello, Miss., linerboard mill and related assets to Georgia-Pacific for $342.5 million. While a takeover defense was probably not its primary reason—St. Regis had been unhappy with its containerboard operations—the sale did serve to make the company less attractive to unwanted suitors. G-P also became a friendly shareholder through the deal, agreeing to buy an 8.5% stake in St. Regis as part of the transaction.

The sale proceeds also improved St. Regis's ability to make acquisitions of its own, and in June the company did just that, agreeing to buy insurer Colonial Penn Group Inc. for $590 million. Like G-P, Colonial Penn became a friendly St. Regis shareholder—its stake amounted to 3.5%—in the preliminary transaction.

Less than a month later, however, St. Regis was targeted for takeover by Australian publisher Rupert Murdoch, who purchased a 5.6% stake in the company in July. Murdoch made a $52/share offer for the rest of St. Regis later that month, threatening an unfriendly and less generous tender offer if he was denied. Murdoch also demanded that the Colonial Penn deal be called off.

St. Regis's board rejected the Australian's offer, however, and blocked a takeover attempt by agreeing in early August to a friendly merger with Champion International in a transaction for stock and cash valued at $1.84 billion. The merger was completed late in 1984.

To pay for the purchase and better integrate the two companies' operations, Champion began almost immediately to sell off pieces of St. Regis. Its first move was to sell the Tacoma, Wash., kraft pulp and paper mill to Simpson Paper Co. The largest transaction, not completed until early 1986, sent most of the company's packaging operations to Stone Container in a deal worth $457 million. Other assets sold off included Hennepin Paper Co., two recycled paperboard mills and related folding carton plants in the Midwest, and the envelope division. In January 1988, Champion transferred the Canadian operations of St. Regis, including a market pulp mill at Hinton, Alta., to subsidiary Weldwood of Canada Ltd. in a deal worth $274 million.

Takeover defenses. Not surprisingly, companies were scrambling in 1984 to take whatever defensive measures they could to discourage unwanted takeover attempts. Some of these defenses make a takeover more difficult by concentrating shares in the hands of friendly holders, staggering directors' terms, and negotiating standstill agreements. Others focus on making a company too expensive through the sale of assets that could be sold off by a raider to finance a takeover, for example. A similar defense involves making a large acquisition to boost the company's purchase price, as St. Regis tried to do with Colonial Penn.

One novel approach developed in 1984 was the "poison pill," which gives special purchase rights to shareholders in the event of a hostile takeover attempt. These rights generally allow the holder to purchase shares at a steep discount once a certain threshold level of ownership—usually 20% to 30%—is surpassed by a hostile buyer. Crown Zellerbach and Owens-Illinois were the first in the paper industry to adopt poison pills, followed by Boise Cascade, Bowater, Great Northern Nekoosa, International Paper, Southwest Forest Industries, and Union Camp Corp, among others.

Crown Zellerbach taken over. A poison pill and a major restructuring were not enough to save Crown Zellerbach from a determined takeover attempt in 1985 by Sir James Goldsmith. The British financier, operating through three affiliated companies, began his attack by purchasing an 8.6% stake in CZ in March 1985 for $78.3 million. In April, Goldsmith made a $42.50/share tender offer for the company, worth $807.5 million. The company rejected that bid as too low, saying it would consider a $60/share offer from Goldsmith or any other source. CZ also announced a major restructuring to separate the company's timberlands and packaging operations from its other businesses.

Still in April, a white-knight agreement with Mead Corp. fell through, but Goldsmith withdrew his tender offer because of CZ's restructuring plan. As CZ's largest shareholder, Goldsmith was elected to the board of directors in May, and he spent the early summer accumulating more shares and fighting management's restructuring plan. Goldsmith's stake jumped from 19.6% at the beginning of May to 26% by early July (activating CZ's poison pill). Goldsmith boosted his stake to 45% in mid-month and finally won control at month's end. The poison pill proved an empty threat because a merger never took place and because a 50% ownership threshold was never reached.

Crown Zellerbach's assets were split up over the next year into four parts. Goldsmith retained the company's timberlands and wood-products businesses. James River Corp. purchased most of CZ's papermaking operations in a stock swap valued at about $765 million. With the purchase, James River became one of the five largest paper companies in the U.S. CZ's container division was spun off as Gaylord Container Corp. and purchased by an investor group for $260 million. Finally, CZ's paper distribution business was sold by James River to Mead for $250 million cash, making Mead the largest integrated distributor of paper in the U.S.

Later in 1985, yet another San Francisco-based company was targeted. The raiders were the Vancouver, B.C.-based Belzberg brothers, who offered $45/share, or about $693 million, for Potlatch Corp. in November 1985. That same month, however, the company bought back its shares from the Belzbergs, who agreed to forego any efforts to take over the company for five years. The $46.7 million buyback, at $43/share, was called greenmail by some observers, but the company said it was part of a broader stock repurchase program that was available to all shareholders.

Hammermill targeted. In July 1986, California investor Paul Bilzerian initiated a hostile takeover bid for Hammermill Paper Co. Hammermill rejected the $52/share offer, worth $900 million, as inadequate and began discussions with other companies about a merger. Bilzerian raised his offer to $57/share, but International Paper put in a higher bid of $64.50/share, worth $1.1 billion, and won control of the company. With its 19% stake, Bilzerian's group collected some $60 million in IP's tender offer. Hammermill has maintained its identity more than most takeover victims. No assets have been sold off, and IP continues to operate it as a separate division.

RESTRUCTURING THE U.S. INDUSTRY

During the back-to-back recessions of 1980 and 1982, several major diversified companies decided to divest their paper industry assets and to invest their money elsewhere. This trend has continued into the second half of the decade.

In 1980, Gulf + Western Industries sold its controlling

FOREIGN OWNERSHIP OF U.S. PULP AND PAPER COMPANIES

Company	% owned	Foreign owner	Assets
Alaska Pulp Corp.	100.0%	Alaska Pulp Co., Japan	Market pulp mill, Sitka, Alaska
Allied Paper Products	100.0	Hanson Industries, U.S. sub. of Hanson Trust, U.K.	Paper mill, Kalamazoo, Mich.
American Fibrit	100.0	Deutsch Fibrit, Fed. Rep. Germany	Molded pulp products mill, Battle Creek, Mich.
Appleton Papers	100.0	Batus, U.S. sub. of B.A.T Industries, U.K.	Pulp/paper mills, West Carrollton, Ohio; Roaring Springs, Pa.; Combined Locks, Wis.
Caraustar Industries	21.5	Settsu, Japan	Eight paperboard mills in South and Midwest
Chin-Am, Morris Paperboard	100.0	National Packaging, People's Rep. China	Paperboard mill, Paterson, N.J.
Container Corp. of America	50.0	Jefferson Smurfit, U.S. sub. of Jefferson Smurfit Group, Ireland	Nine pulp/paperboard mills
Daishowa America	100.0	Daishowa International, U.S. sub. of Daishowa Paper Mfg., Japan	Paper mill, Port Angeles, Wash.
FSC Paper	100.0	Smorgon Consolidated Industries, Australia	Deinked pulp/newsprint mill, Alsip, Ill.
Groveton Paper Board	69.0	SPB Canada, Canada	Paperboard mill, Groveton, N.H.
Keyes Fibre	100.0	Royal Packaging Industries, Van Leer, Netherlands	Six molded pulp products mills
Leaf River Forest Products	5.0	Kymmene Strömberg, Finland	Market pulp mill, New Augusta, Miss.
Macon Kraft	100.0	Pratt Holdings, Australia	Linerboard mill, Macon, Ga.
Madison Paper	60.0	Myllykoski, Finland	Pulp/paper mill, Madison, Wis.
Mohawk Paper Mills	40.0	Stora Group, Sweden	Paper mills, Cohoes and Waterford, N.Y.
Newton Falls Paper Mill	100.0	Stora Group, Sweden	Paper mill, Newton Falls, N.Y.
North Pacific Paper	10.0	Jujo Paper, Japan	Pulp/newsprint mill, Longview, Wash.
Portals Inc.	100.0	Portals Ltd., U.K.	Paper mill, Hawkinsville, Ga.
Port Townsend Paper	100.0	Haindl Papier, Fed. Rep. Germany	Pulp/paper/paperboard mill, Port Townsend, Wash.
Schoeller Technical Papers	100.0	Felix Schoeller Jr., Fed. Rep. Germany	Paper mill, Pulaski, N.Y.
Jefferson Smurfit Corp.	78.0	Jefferson Smurfit Group, Ireland	Eleven pulp/paper/paperboard mills[1]

[1] Not including Container Corp. of America mills.

interest in Brown Co. to James River Corp., which got most of Brown's pulp and paper operations and some timberland, and also to Pope & Talbot Inc., which purchased two recycled tissue mills in Wisconsin. ITT Corp. in 1980 sold its two British Columbia pulp mills and related forest-products operations to Western Forest Products Ltd. ITT put its four U.S. pulp mills and related timberlands on the block, but it could not find a buyer at the reported $3-billion asking price.

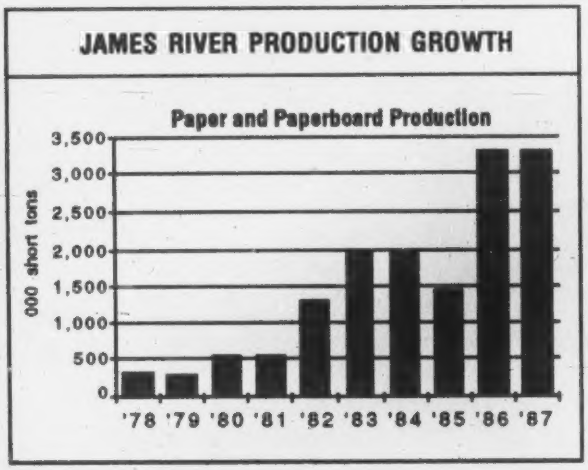
In 1982, American Can Co. sold its Dixie/Northern tissue and bleached board operations as well as some timberland to James River. The following year, the company completed its pullout from the industry by selling its Marathon, Ont., pulp mill to James River and by selling its 50% interest in a Halsey, Ore., pulp mill to Pope & Talbot.

The pace, if not the scale, of divestitures picked up as the recession waned in 1983 and investment opportunities blossomed. Several companies shed their paper-industry assets in favor of less cyclical investments.

In May 1983, Time Inc. announced the spin-off of its Inland Container Corp. and Temple-Eastex Inc. units into a new company, Temple-Inland Inc., in order to increase investments in its video and publishing units. In June, Litton Industries Inc. moved to concentrate on its electronics businesses, selling the major part of its Paper, Printing & Forms Group to Technographics Inc. in an LBO worth about $70 million. Also in June, Clevepak Corp. sold its partition mill division and other packaging assets to Rock-Tenn Co. for about $40 million. And in August, Phillips Petroleum Co. sold its H.P. Sith Paper Co. unit to James River for $34.5 million.

Such moves to take advantage of better paper-industry conditions extended into 1984 when Sonat Inc. sold its 50% interest in Boise Southern Co. to partner Boise Cascade Corp. for $217 million. Also in 1984, Britain's Bowater Corp. spun off its North American operations in a tax-free "demerger" that automatically created the largest U.S.-based newsprint producer, Bowater Inc.

In order to expand and to diversify its product lines, Chesapeake Corp. purchased Wisconsin Tissue Mills and Plainwell Paper Co. from Philip Morris Inc. in April 1985 for $214 million. A month later, Philip Morris exited the industry with the sale of Nicolet Paper Co. to Hammermill.


JAMES RIVER PRODUCTION GROWTH

In May 1986, Boise Cascade expanded into the southeastern white-paper market with the $150-million purchase of Allied Paper's bleached kraft pulp and paper mill in Jackson, Ala. Boise acquired the mill from Hanson Trust plc., which had picked up Allied in a hostile takeover of SCM Corp. earlier that year Also in 1986, Times Mirror Co. sold 80% of Publishers Paper Co. to Jefferson Smurfit for $150 million. The deal, Smurfit's first foray into the newsprint sector, included a long-term supply contract for newsprint for Times Mirror publications.

Smurfit was also involved in another big divestiture of 1986: Mobil Corp.'s sale of Container Corp. of America. CCA was purchased by a partnership of Smurfit and a Morgan Stanley investor group for $1.16 billion. Mobil had owned CCA since 1976.

Owens-Illinois Inc. began the process of exiting from the industry in early 1986, when it agreed to sell its Orange, Texas, linerboard mill and related assets to Temple-Inland for $228 million. After a leverage buyout by Kohlberg Kravis Roberts Inc. in early 1987, O-I's Forest Products Group was sold to Great Northern Nekoosa in July. Intense bidding for these prime containerboard assets, during a period of excellent market conditions, helped drive up the price to $1.15 billion, near replacement cost.

Repositioning businesses. Companies inside the industry have also moved to streamline their operations and rethink their business strategies. The result has been a steady stream of sales and acquisitions, as companies move to shed operations that no longer fit their plans and to expand into new areas.

In a major restructuring to focus on its core businesses, Mead Corp. ended joint ventures with Temple-Inland and Scott Paper in 1987 and 1988, and it also sold its recycled paperboard business to Rock-Tenn Co. In dissolving the joint ventures, the Georgia Kraft Co. linerboard mill at Macon, Ga., was sold to Pratt Holdings Pty Ltd. of Australia for an undisclosed amount, and Brunswick Pulp & Paper Co. was sold to Georgia-Pacific Corp. for $665 million. The Brunswick mill will more than double G-P's bleached-board capacity, and it will double the company's export capacity for market pulp.

Louisiana-Pacific took steps in 1987 to distance itself from asbestos liability and to leave the containerboard sector with the spin-off of Fibreboard Corp. The move concentrates L-P's assets in market pulp and forest products. Fibreboard's containerboard division was sold to Gaylord Container Corp. for $156 million.

In a move to concentrate on printing and writing papers, Pentair Inc. sold its Port Huron, Mich., specialty papers mill to E.B. Eddy Forest Products Ltd. of Canada in August 1987. Pentair's other specialty papers mill in Detroit, Mich., was sold in December to Kapaco Group.

Aggressive expansion. Some firms have expanded rapidly by buying assets from companies eager to leave the industry or to streamline their businesses. James River

Corp., which began as a one-mill operation in 1969, is the best example of this strategy. James River climbed into the top five by purchasing either assets divested by companies leaving the industry or assets being sold off after takeovers. After the Brown Co. deal with G+W in 1980, the purchase in 1982 of American Can's U.S.-paper-industry assets for $446 million more than doubled James River's size, further integrated the company into pulp production, and made it a major national producer of tissue and folding cartons.

In 1983, the company paid $170 million for Diamond International's pulp and papermaking assets, adding to its white-paper capacity and extending its tissue and towel business in the Northeast. In 1986, James River moved into the top five among paper companies with the purchase of Crown Zellerbach's paper operations for $1.43 billion.

The company has also moved aggressively to expand in the international market, particularly in Europe. In 1987, James River purchased 50% of the Kaysersberg Div. of French papermaker Beghin-Say for $243 million. Kaysersberg's tissue and nonwovens business will be used as a platform for expansion in Europe, the company said.

Stone Container Corp. more than doubled its capacity with the purchase of Continental Forest Industries' Brown System operations for $510 million in 1983. In 1986, the company purchased most of the packaging operations of Champion International for $426 million after Champion's merger with St. Regis. The deal made Stone the world's largest producer of unbleached kraft packaging products. The company added to its containerboard capacity with the purchase and reactivation of the former Jacksonville Kraft Co. mill in Jacksonville, Fla., in a partnership called Seminole Kraft Corp. Finally, Stone completed a friendly merger with Southwest Forest Industries in 1987 for $760 million, adding another linerboard mill and branching out into newsprint.

While the majority of recent deals have involved papermaking assets, a few firms have looked outside the industry for expansion opportunities. One example is Fort Howard Corp., which acquired Maryland Cup Corp., a maker of disposable packaging products for the commercial and industrial market, for $500 million in 1983. In 1986, the company expanded its cup market share from about 18% to 31% with the purchase of Lily-Tulip Inc. for $326 million. The deal moved Fort Howard ahead of James River's Dixie-Northern operation and into first place in the sanitary food container sector.

Leveraged buyouts surge. In an LBO, a small group of investors—often composed of company management—finances an acquisition through loans secured by the assets being purchased, and the loan is then repaid from funds generated by company operations or the sale of company assets. LBO's have been used successfully to finance paper-industry acquisitions since the beginning of the decade, but they have come into their own within the past year or so, as more funds have been set up to pursue deals.

The main reason for the popularity of LBO's is the opportunity for great profit. For example, Ecusta Corp. was taken private for $130 million in 1985 in a buyout from Olin Corp.; in 1987, the company was sold to P.H. Glatfelter Co. for $219 million. LBO's have also been used to escape hostile takeovers, as when National Gypsum Co. went private in 1986 in a $1.1 billion buyout to escape a takeover attempt by the Canadian investor Samuel Belzberg.

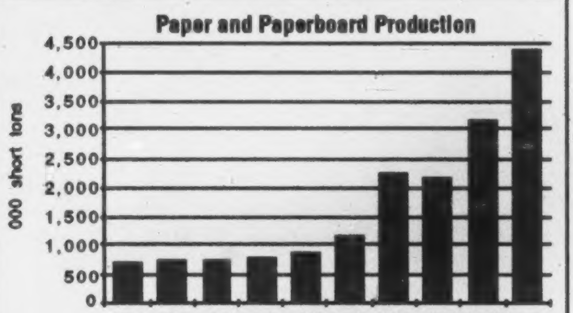
The biggest name in the LBO industry is Kohlberg Kravis Roberts. In 1987, KKR bought out Owens-Illinois for $3.66 billion and Jim Walters Corp. for $2.44 billion. In both cases, paper-industry assets were sold off to help finance the deals. Great Northern Nekoosa was the buyer in both cases, purchasing O-I's Forest Products Group in 1987 for $1.15 billion and Jim Walters Papers in 1988 for an undisclosed amount.

Foreign interests. A significant number of recent acquisitions in the U.S. paper industry have been made by foreign companies. The Japanese made their first direct purchase of a U.S. paper mill only in 1987, when Daishowa purchased an uncoated groundwood paper mill in Port Angeles, Wash., from James River for $75 million. Daishowa and Louisiana-Pacific had announced in February 1987 that Daishowa would buy Fibreboard Corp. for $160 million, but the deal fell through for unexplained reasons in June 1987.

Also in 1987, Settsu Corp. of Japan acquired a 21.5% interest in Caraustar Industries Inc., the fourth largest U.S. producer of recycled paperboard. Settsu, Japan's largest recycled board producer, purchased the stake to give it a presence in the U.S. market.

Australians were also active in the U.S. market in 1987. FSC Paper Corp. was sold to Smorgon Consolidated Industries Pty Ltd. in May. Smorgon, a recycled containerboard producer based in Melbourne, said it purchased the mill as a stepping stone into the U.S. market. In July, a little known Australian company called Pratt Holdings Pty Ltd. acquired the Macon, Ga., mill of Georgia Kraft Co. for an undisclosed amount.

STONE CONTAINER PRODUCTION GROWTH

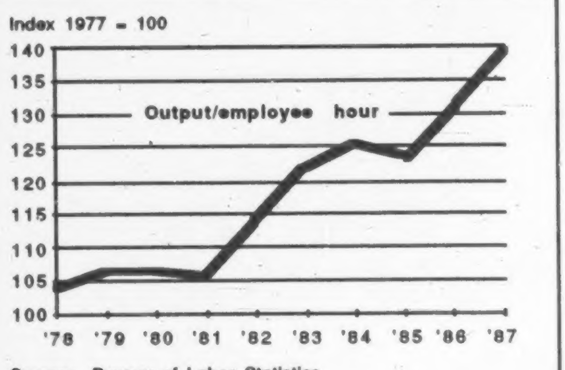


LABOR

In 1987, the employment of production workers and nonsupervisory employees in the paper and allied products industries amounted to about 515,000 people. This is down slightly from the 523,000 production workers employed in 1986, when employment in the paper and allied products industries reached its highest level since 1981. This increase in numerical strength came entirely from the converted products sector, however, as the total workforce at pulp, paper, and paperboard mills declined during the same period.

Improvements in technology are responsible for at least a portion of the job losses at the mill level since the beginning of the decade. Paper companies have realized that a significant aspect of any modernization of their facilities is a reduction in labor costs, as less manpower is needed to operate essential machinery. For the unionized workers, who represent the majority of the U.S. mill workforce, the technological advances that have been made in individual mills, coupled with the reduction in the number of workers

PRODUCTIVITY OF PRODUCTION WORKERS AT PULP, PAPER AND BOARD MILLS



Source: Bureau of Labor Statistics

U.S. PAPER AND ALLIED PRODUCTS EMPLOYMENT AND EARNINGS, 1965-87

Year	All employees (000)	Production workers (000)	Average hourly earnings	Average weekly earnings
1987	678.2	515.0	$11.41	$492
1986	674.3	511.4	11.14	483
1985	677.7	512.1	10.83	467
1984	680.9	511.6	10.41	449
1983	661.2	494.5	9.93	423
1982	662.4	493.9	9.32	390
1981	688.5	518.4	8.60	366
1980	692.8	522.7	7.84	331
1979	706.8	535.6	7.13	304
1978	698.7	524.7	6.52	280
1977	691.6	518.2	5.96	256
1976	675.5	508.3	5.47	232
1975	642.0	479.7	5.01	208
1974	706.1	544.3	4.53	191
1973	704.6	543.1	4.20	180
1972	688.9	531.6	3.95	169
1971	681.9	521.8	3.67	155
1970	705.5	543.2	3.44	144
1965	639.1	497.7	2.65	114

Source: Bureau of Labor Statistics.

at those mills, has had far-reaching implications.

The largest U.S. pulp and paper workers' union is the United Paperworkers International Union, headquartered in Nashville, Tenn. The UPIU currently has 240,000 members; about 3,000 of this total are employed in mills in Canada. Workers at mills on the Pacific Coast are almost entirely represented by the Assn. of Western Pulp & Paper Workers, whose main office is located in Portland, Ore. The AWPPW currently represents 15,000 workers.

In addition to these two major organizations, smaller groups of unionized workers at various pulp and paper mills are members of a score of other union groups, ranging from the International Assn. of Machinists and Aerospace Workers to the United Steelworkers of America. In some cases, such as at Midtec Paper Corp. Inc.'s mill at Kimberly, Wis., mill workers belong to their own independent union.

Reflecting the trend in overall employment at the mill level, UPIU and AWPPW membership has also been declining since the beginning of the decade. The unions, therefore, have been unable to wield as much power as in the past. This loss of union clout at the bargaining table, coupled with a high unemployment rate in most job sectors and increasing company insistence on cost-cutting measures to remain competitive, has resulted in more modest wage increases than in the past.

Average wage increases drop. Wage increases were modest in 1987 and will continue to be so in 1988. For Pacific Coast bargaining, 1987 was a big year, and wage increases were nonexistent in some contracts, which helped bring wages more in line with those of union members throughout the country. A case in point is the three-year contract Weyerhaeuser Co. concluded in 1987 with AWPPW members at five of its mills in the Pacific Northwest. The contract froze wages but included a $650 payment in the first year and a provision for pay increases of up to 4%/year, depending on each mill's profitability.

Settlements in 1987 were typical of a trend that has been ongoing since the beginning of the decade. According to American Paper Institute data, average first-year wage increases in the U.S. pulp and paper industry have been reduced from 8.7% in 1981 to 0.37% in 1986. The Pacific region, where workers have traditionally been the highest paid of all the areas of the country, suffered the most severe cutbacks from 1983 to 1985, as employers tried to bring their labor costs in line with those of other regions.

HOURLY EARNINGS OF U.S. PAPER AND ALLIED INDUSTRY PRODUCTION WORKERS, 1981-87

	1987	1986	1985	1984	1983	1982
Paper and allied products	$11.41	$11.14	$10.82	$10.41	$9.93	$8.60
Paper and pulp mills[1]	14.00	13.59	13.13	12.43	11.70	10.06
Paperboard mills	14.26	14.00	13.60	12.99	12.11	10.23
Misc. converted paper products	n.a.	9.58	9.32	9.09	8.71	7.58
Paperboard containers/boxes	n.a.	9.54	9.23	8.92	8.60	7.53
All U.S. manufacturing	9.90	9.73	9.53	9.19	8.83	7.99

1. Includes construction paper/board mills.
n.a. = Not available.

Source: Bureau of Labor Statistics.

TOTAL U.S. PAPER AND ALLIED PRODUCTS INDUSTRY EMPLOYMENT BY SEGMENTS, 1981-86

(000 employees)

	1987	1986	1985	1984	1983	1982
Paper and allied products	678.2	674.3	677.7	680.9	661.2	653.0
Paper and pulp mills[1]	193.3	195.2	197.0	200.0	198.0	196.6
Paperboard mills	52.9	53.3	55.3	57.2	58.2	59.5
Misc. converted paper products	233.2	229.5	228.5	226.5	214.4	208.4
Paperboard containers/boxes	198.8	196.3	196.9	197.2	190.6	188.5

1. Includes construction paper/board mills.

Source: Bureau of Labor Statistics.

More recently, this trend has been characterized by the substitution of lump-sum payments in the first year of labor contracts, with any general wage increase deferred until the second or third year of the contract term. This concept has, of course, been beneficial for companies both in maintaining a lower wage base and in reducing the multiplier effect on benefits and pensions in any one year.

Even with the recent reductions in contract wage settlements, hourly earnings of paper and allied industry production workers in November 1987 averaged $11.44/hour. In 1986, earnings averaged out to $11.14/hour. That compares with $9.73/hour for production workers in all other U.S. manufacturing industries. The hourly earnings for production workers in the paper industry increased about 15.3% between 1981 and 1986.

The most highly paid workers in the paper industry are those employed directly at the mill level, where paper and pulp workers earned an average of $13.59/hour in 1986. In October of 1987, the average wage of these primary workers had reached $14.10/hour. Workers in paperboard mills received even higher compensation, an average of $14.00/hour in 1986. This increased to $14.39 in October 1987. These figures represent increases of almost 21% and 19.5%, respectively, between 1981 and 1986. The average wages for workers in corrugated container converting operations are less than those for manufacturing workers in other industries, and their earnings have risen by only 12.8% since 1981. In October 1987, these workers were earning $9.93/hour, according to the U.S. Dept. of Commerce's Bureau of Labor Statistics.

Bargaining in 1988. Some 85 to 90 contracts are up for negotiation in 1988, with about a third of these coming due in the South. Most of the contract negotiations occurring in the West will take place at Canadian mills.

In 1987, the paper industry and the unions continued to clash over the issues of premium pay for Sunday and holiday work, wage increase percentages, hikes in employee contributions to health-care plans, and the ability to engage

AVERAGE FIRST-YEAR WAGE INCREASES IN U.S. PULP AND PAPER INDUSTRY, 1979-88*

Year	New England	East	Midwest	South	Pacific	Total U.S.
1988*	0.0%	n.a.	2.1%	0.0%	n.a.	0.3%
1987	0.3	1.3%	0.6	0.1	0.0%	0.4
1986	1.0	0.6	0.5	0.1	0.2	0.3
1985	2.3	3.4	3.2	1.6	–1.1	2.1
1984	4.9	4.3	4.6	5.3	–0.9	3.3
1983	5.8	5.2	5.1	5.9	1.3	5.6
1982	7.3	6.7	6.6	6.8	7.7	6.9
1981	8.8	9.0	8.5	8.2	9.0	8.7
1980	10.7	9.8	9.3	8.7	9.8	9.2
1979	9.6	9.4	9.5	10.0	10.0	9.6

* Through first quarter.
n.a. = Not available.

Source: American Paper Institute.

U.S. PAPER WORKERS UNIONS

Union	Region represented	No. of members	No. in primary pulp and paper
United Paperworkers International Union	U.S.	240,000*	60,000
Association of Western Pulp & Paper Workers	Western U.S.	15,000	15,000

* Includes approximately 40,000 employed in areas such as chemicals and hospitals.
International Assn. of Machinists & Aerospace Workers, International Brotherhood of Electrical Workers, and other major unions also have representation at U.S. mills.

in flexible scheduling of mill personnel. The industry is not expected to back down on these issues in 1988 negotiations. Companies feel that in the face of increasing international competition from countries such as Brazil, Rep. Korea, and Taiwan, plus competition from plastic products, they cannot afford to operate without winning these concessions from the unions.

In line with the strategy of curtailing long-term costs, companies will continue to negotiate contracts that contain lump-sum payments instead of committing to wage increases over the period of a three- or four-year contract. Richard P. Klinzing, vice president of employee relations for the American Paper Institute, observed that about two-thirds of the contracts concluded in both 1986 and 1987

PRODUCTIVITY INDEXES FOR U.S. PAPER AND ALLIED PRODUCTS

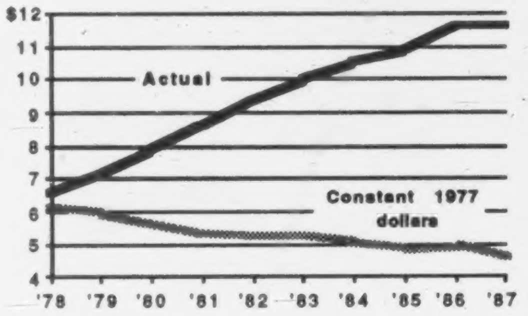
(output per employee hours; 1977 = 100)

	Production workers	All employees
PULP, PAPER, AND BOARD MILLS		
1988e*	143.2	139.8
1987	139.8	136.4
1986	131.4	128.8
1985	123.6	122.2
1984	124.0	121.9
1983	121.4	119.6
1982	113.7	111.3
1981	105.5	104.4
1980	106.4	105.2
1979	106.2	105.4
Avg. annual percent change 1979-85	3.3%	3.2%
1978	103.7	103.2
1977	100.0	100.0
1976	95.0	95.0
1975	87.7	86.7
1974	90.5	91.5
1973	90.2	91.5
1970	75.8	77.5
1960	48.8	50.6
1954	37.9	40.4
Avg. annual percent change 1947-85	4.1%	3.7%
CORRUGATED AND SOLID FIBER BOXES		
Avg. annual percent change 1958-85	4.0%	3.7%
1973-85	2.6	2.5
FOLDING PAPERBOARD BOXES		
Avg. annual percent change 1963-85	1.9%	1.8%
1973-85	0.6	0.6

* American Paper Institute data.
e = Estimate.

Source: Bureau of Labor Statistics.

AVERAGE HOURLY EARNINGS OF PRODUCTION WORKERS



Source: Bureau of Labor Statistics

REPRESENTATIVE BASE-WAGE RATES FOR REGIONS OF NORTH AMERICA 1970-87

	U.S.		Canada	
Year	South	West	Eastern	B.C.
1989	—	—	C$15.37	C$16.17
1988	—	—	14.71	15.33
1987	$13.59*		14.26	14.48
1986	—	—	14.01	14.09
1985	—	—	13.34	14.09
1984	9.51	11.22	12.83	13.48
1983	9.07	11.19	12.52	12.96
1982	8.56	11.05	11.38	12.96
1981	7.91	9.37	10.16	11.46
1980	7.28	8.53	9.23	9.96
1979	6.74	7.90	7.89	9.06
1978	6.13	7.25	7.46	8.16
1977	5.57	6.59	6.99	7.61
1976	5.04	5.96	6.47	6.89
1975	4.58	5.26	5.88	6.14
1974	4.15	4.78	4.57	5.10
1973	3.78	4.32	4.21	4.45
1972	3.48	4.02	3.85	4.09
1971	3.28	3.76	3.51	3.80
1970	3.09	3.45	3.25	3.50

*National average.

Sources: *Pulp & Paper Week*, American Paper Institute.

contained lump-sum payments in the first year. He said that paper companies are interested in making the labor component of their costs more stable. Consequently, more mills are negotiating three-year contracts instead of two-year contracts. API figures show that, through October 1987, 50 of the 65 settlements concluded were three-year contracts and only nine were for two years.

Klinzing said contracts that contain provisions for variable pay based on mill performance, which came on the scene about five years ago, will continue to play a small part in 1988 negotiations. Since these kinds of contracts require a lot of study and experimentation, their implementation will be slow.

He also pointed out that 1988 bargaining could be affected by the fact that the UPIU will hold elections for its top officers, including president Wayne Glenn. Should a new slate be elected, labor's bargaining agenda could change. Another unknown is whether UPIU locals will bargain collectively, as they are doing in negotiations with International Paper Co. and Georgia-Pacific Corp.

Coping with strikes. "Companies' commitment to running their mills during a strike is very strong," Klinzing said. It is a matter of debate among companies right now whether this will take the form of permanent or temporary replacements. Some companies have already shown they are willing to incur the short-term costs of having to replace their entire work force rather than give in on these issues. For example, International Paper and Stone Container Corp. permanently replaced striking union workers in 1987.

In recent years, companies have been able to cope better with strikes because increasingly mechanized mills can be run at least partially by supervisory personnel. Recent court decisions have upheld the right of management to hire temporary replacements for any striking workers. All of which have made a strike a less acceptable tactic from the union point of view and certainly a less successful means of obtaining a contract in its favor.

Throughout 1987, the UPIU maintained that its members should not be asked to concede on issues of premium pay or work rules during a period when paper companies were earning record profits. This argument lost some of its force after the stock-market collapse. Paper company stocks lost between 20% and 30% of their value in October 1987. This is another reason wage increases in 1988 will be modest.

The UPIU and other unions are lobbying Congress to limit companies' rights to replace striking workers permanently. During testimony before the President's Advisory Committee on Mediation & Conciliation in 1987, Glenn said he felt that labor-management relationships in the paper industry were at their lowest point during his lifetime in the labor movement. He testified that most of the European democracies and Canada already have federal legislation that protects strikers' jobs. He said he believed collective bargaining will fail in the U.S. unless appropriate legislation is adopted.

On Jan. 6, 1988, the UPIU began an expanded campaign against IP. The UPIU struck three of IP's mills (Jay, Maine; De Pere, Wis.; and Lock Haven, Pa.) in the spring of 1987. The union locals will pool votes on three issues: premium pay for Sunday work, maintaining the length of contracts, and subcontracting out of existing jobs. IP hired permanent replacement workers at all of these mills. The union demands that all replacement workers be removed before its members will return to work. It seems unlikely that IP will comply with this last demand.

For the last ten years, the industry has been successfully running its mills during strikes, as was the case with Boise Cascade Corp.'s mill at Rumford, Maine, in 1986. Striking union employees there were replaced by permanent new hires, and those who were able to return to their jobs, after 75 days on the picket lines, accepted a contract whose provisions differed little from the one they had rejected originally.

Canadian unions more protected. Provincial labor laws in Canada provide more protection for striking union members than do U.S. laws. For example, Quebec mills can run their struck mills with only management people. Quebec contains about one-third of Canada's paper industry and produces at least 40% of the country's newsprint.

The companies located in the two other major paper-producing provinces, Ontario and British Columbia, are permitted to hire temporary workers to run struck mills. A mill is required to wait a specified length of time before it can hire permanent replacements for strikers in these provinces.

TIMBER RESOURCES AND PULPWOOD COSTS

Despite lower interest rates and the effects of the weak U.S. dollar, many U.S. paper companies have been reluctant to hold timberland. Selling timberland is a quick way to raise cash—a handy thing to have in a market rampant with takeovers and mergers. Also, the new tax law makes it less desirable to hold large tracts of timberland. (Until 1987, companies that harvested timber enjoyed a tax advantage over companies that manufactured value-added products.) The eradication of favorable capital-gains taxes will pinch companies that sell large amounts of timber, such as Weyerhaeuser Co., International Paper Co., Champion International Corp., and Georgia-Pacific Corp. And perhaps most importantly, the availability of increasing amounts of Canadian lumber on the U.S. market persuaded many U.S. companies to reduce timber production.

Since the late 1970s, timber values in the U.S. have declined, and companies with large timber tracts have not usually performed as well as those that focus more on manufacturing, such as Fort Howard Corp. and Stone Container Corp. (Stone has been selling off the 334,000 acres of timberland it acquired when it purchased Southwest Forest Industries Inc. in April 1987.) In 1987, however, large timber holders benefited from an extremely strong world lumber market.

Optimism also stems from overharvesting in British Columbia, the southern U.S., and Sweden; the weak dollar; and the U.S. Forest Service's (USFS) desire to reduce allowable timber harvests. Demand for pulpwood by the surging pulp and paper industry and a wood-products export market that is expected to double by 1990 will also contribute to the revival in timber values. However, the outlook for U.S. housing starts is not so optimistic.

U.S. housing starts in 1987 amounted to about 1.62 million. This was down from 1.805 million in 1986. A large part of the downturn can be attributed to the October 1987 stock-market crash, which bred uncertainty about the future direction of interest rates. For 1988, housing starts are expected to total about 1.4 million.

In 1988-89, much of the steady demand for lumber and other wood products will be generated by home repairs and

PROJECTED FUTURE U.S. DEMAND FOR TIMBER PRODUCTS 1976-2030

Product	Standard unit of measure	Consumption 1976	Projected demands—medium level 2000	Projected demands—medium level 2030
Lumber	Billion bd ft	42.7	59.9	67.3
Plywood	Billion ft^2, 3/8-in. basis	20.7	30.1	34.1
Board (particleboard, insulating board, and hardboard)	Billion ft^2, 3/8-in. basis	13.5	27.3	37.3
Pulpwood (U.S. mills)	Million cords	75.2	127.7	178.4
Other industrial products	Million ft^3	379.0	800.0	900.0
Fuelwood (roundwood)	Million cords	8.1	18.7	30.7
Total roundwood, sawtimber	Billion ft^3	13.3	22.7	28.3

Source: U.S. Forest Service, "An Analysis of the Timber Situation in the U.S., 1952-2030," 1982.

remodeling, making up for rapidly declining commercial construction. It is estimated that U.S. citizens spent about $95 million on residential repairs and alterations in 1987, a 4% increase over 1986. This modest increase followed four years of growth during which spending on residential repairs and alterations more than doubled. Construction of multifamily units has declined because it is harder to use these items as tax shelters and because too many of them are going empty in U.S. cities. Between 1986 and 1987, multifamily starts declined 24.4% to 473,500 units.

The weak U.S. dollar enabled U.S. producers to make up lost ground in the wood-products trade. U.S. exports of lumber, logs, plywood, veneer, and other wood products amounted to $3.9 billion in 1987, the Dept. of Commerce reported. About $1.5 billion of that was softwood logs, while $850 million was softwood lumber. In 1987, the U.S. exported 2.4 billion bd ft of softwood lumber and 4.0 billion bd ft of softwood logs.

U.S. PULPWOOD RECEIPTS

(000 standard cords, rough wood basis)

			Domestic, of which			Imported, of which	
Year	**Total receipts**	**Total domestic**	**Soft-woods**	**Hard-woods**	**Total imported**	**Soft-woods**	**Hard-woods**
1986	91,115	90,280	n.a.	n.a.	835	n.a.	n.a.
1985	85,349	84,561	n.a.	n.a.	788	n.a.	n.a.
1984	88,035	87,114	n.a.	n.a.	921	n.a.	n.a.
1983	82,390	81,587	58,959	23,431	803	n.a.	n.a.
1982	73,541	72,524	n.a.	n.a.	1,016	n.a.	n.a.
1981	79,336	78,283	n.a.	n.a.	1,053	n.a.	n.a.
1980	81,007	80,320	59,582	20,738	687	588	99
1979	76,928	76,124	56,741	19,383	804	698	106
1978	74,824	73,970	54,803	19,167	854	764	90
1977	72,867	72,094	54,680	17,414	773	709	65
1976	72,265	71,443	53,689	17,753	882	744	78
1975	65,456	64,836	48,759	16,079	618	521	96
1974	77,103	76,262	55,531	658	841	658	183
1972	70,273	69,254	51,793	17,461	1,020	884	135
1970	68,863	67,723	53,356	16,367	1,140	994	146

Year	**Northeast**[1]	**North Central**	**South Atlantic**	**South Central**	**West**
1986	6,267	6,768	55,439[2]		11,937
1985	6,081	5,916	52,620		11,320
1984	5,842	5,271	26,640	26,322	11,824
1983	7,357	6,777	24,544	28,457	15,261
1982	7,075	5,160	23,580	24,725	13,001
1981	7,623	5,537	25,146	26,521	14,509
1980	7,159	5,969	n.a.	n.a.	16,496
1979	6,777	5,956	n.a.	n.a.	14,477
1978	6,892	5,522	25,353	25,678	13,483
1977	5,887	5,364	n.a.	n.a.	14,937
1976	5,712	5,441	n.a.	n.a.	14,766
1975	5,320	4,574	19,907	22,151	13,504
1974	6,547	6,401	23,414	24,953	15,986
1972	5,398	4,935	22,334	23,113	14,492
1970	5,958	5,245	21,835	20,493	15,367

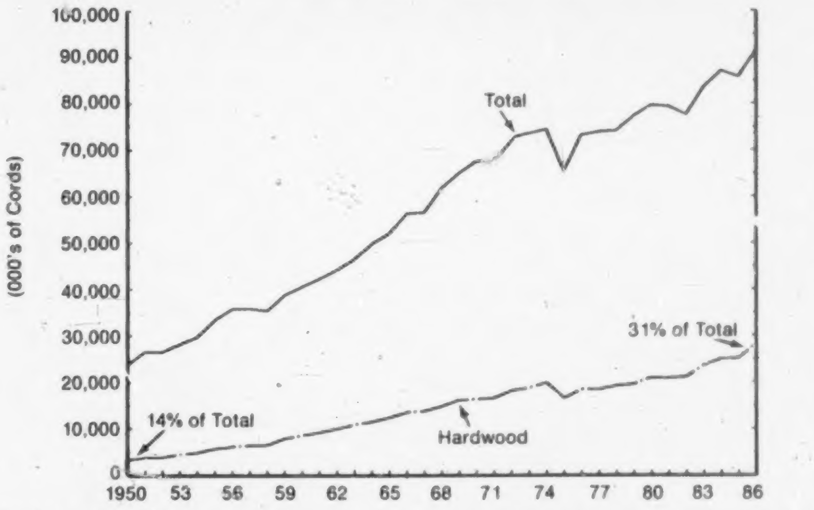
n.a. = Not available.

1. Regional statistics for 1984, 1985, and 1986 do not add to total because of difference in method of reporting.

2. Figures for 1985 and 1986 are for entire South.

Source: Bureau of the Census, "Current Industrial Reports Series M26A."

U.S. PULPWOOD CONSUMPTION, HARDWOOD AND TOTAL



Sources: 1950–1984 U.S. Department of Commerce; 1985 and 1986 American Pulpwood Assn.
Graph: American Paper Institute
March 1987

U.S. PULPWOOD CONSUMPTION

(000 standard cords, rough wood basis)

Year	Total consumption	Northeast	North Central	South Atlantic[1]	South Central[1]	West
1986	90,554	7,700	7,220	59,099		16,534
1985	84,841	7,650	6,209	55,631		15,351
1984	86,948	5,943	5,049	26,326	26,046	11,435
1983	82,386	7,384	6,683	24,814	28,314	15,186
1982	73,642	6,714	5,394	23,574	24,935	13,025
1981	79,350	7,043	5,865	25,228	25,457	14,757
1980	79,703	7,318	5,715	24,960	26,246	15,465
1979	77,362	6,748	5,728	24,426	25,421	15,038
1978	74,170	6,501	5,492	23,703	25,118	12,784
1977	73,935	5,949	5,473	22,817	24,668	15,063
1976	72,011	5,877	5,442	22,673	24,969	14,247
1975	65,421	5,417	4,779	19,983	22,042	13,200
1974	74,327	6,149	5,678	22,926	22,240	15,466
1972	71,538	5,878	5,222	22,395	23,212	14,831
1970	67,562	5,699	5,034	21,511	20,458	14,822

1. Figures for 1985 and 1986 are for entire South.

Source: Bureau of the Census, "Current Industrial Reports Series M26A."

Japan was a big buyer of U.S. lumber in 1987. Lumber demand in that country was stimulated by the government's programs to increase consumer spending, which caused more people to construct or repair houses. This brought 1987 starts in Japan to 1.6 million, well above the levels of the early 1980s, although the upward trend is being somewhat curtailed by rapidly increasing land prices.

U.S. TIMBER RESOURCE

The growing stock in U.S. forests has increased from about 603 billion ft^3 in 1960 to about 711 billion ft^3 in 1987, the American Forest Council (AFC) estimated. U.S. forestland totals about 737 million acres. Of this, about 482 million acres are commercial (land capable of growing over 20 ft^3 of wood/acre/year), according to AFC. Fifty-eight percent of the land, about 279 million acres, is privately owned. (AFC estimated that there are about four million individual woodland owners in the U.S.) About 13% of commercial U.S. forestland, or 67.5 million acres, is owned by industry, and 135 million acres are public lands owned by federal, state, and local governments.

Under the National Forest Management Act of 1976, USFS must make resource management plans for each of the 123 national forests it manages. Although many of these plans are being challenged in court by various groups, USFS intends a sizable reduction in allowable timber harvests by 1990. The forest-products industry believes that current timber sales levels are far below the productive capacity of the national forest system. National forests contain over 50% of the harvestable sawtimber in the U.S.

A forest-industry analysis of the federal budget for fiscal year 1989 (beginning in October 1988) shows that the Reagan administration's proposal to sell 11.2 billion bd ft of timber from the national forests is far below the volume needed to meet the growing public demand for forest products. For the 1988 fiscal year, the federal budget approved the sale of about 11.5 billion bd ft of timber from the national forests.

The forest-products industry wants a timber sale level of 13 billion bd ft. It is particularly concerned because high timber demand has resulted in steep erosion in the reserve volume of national-forest timber now under contract. Reserve volume in the national forests amounted to 38.1 billion bd ft in 1985, but it is now less than 25.1 billion bd ft. The industry pointed out that the timber sale program

PULPWOOD CONSUMPTION, EXPORTS, IMPORTS, AND PRODUCTION IN THE U.S., SPECIFIED YEARS 1952-84, WITH PROJECTIONS TO 2030

(million cords)

				Production				
				Total	Roundwood			Chips[1]
Year	Consumption	Exports	Imports		Total	Softwoods	Hardwoods	
1984	91.4	1.9	1.8	91.5	54.8	34.7	20.0	36.8
1976	75.3	3.3	1.1	77.4	47.6	33.0	14.7	29.8
1970	69.6	2.0	1.1	70.5	50.2	36.7	13.6	20.2
1962	44.1	0.1	1.4	42.8	33.3	24.3	9.0	9.4
1952	27.2	—[2]	2.1	25.0	23.5	20.0	3.5	1.6

PROJECTIONS

				Demand for U.S.				
				Total	Roundwood from U.S. timberland			Plant by-products
Year	Demand in U.S. mills	Exports	Imports		Total	Softwoods	Hardwoods	
1990	92.8	2.3	1.4	93.7	59.8	36.4	23.4	33.9
2000	105.2	1.9	1.3	105.8	69.5	39.4	30.1	36.3
2010	115.1	1.7	1.2	115.6	78.4	42.0	36.4	37.2
2020	124.6	1.6	1.1	125.1	86.6	44.4	42.2	38.5
2030	133.0	1.5	1.0	133.5	94.2	46.5	47.7	39.3

1. Includes primary processing plant byproducts, such as slabs, edgings, and veneer cores as well as unknown volumes of pulp chips produced directly from roundwood at logging sites and other locations remote from pulp mills.
2. Less than 50,000 cords.
Note: Data may not add to totals because of rounding.

Sources: U.S. Dept. of Agriculture, Forest Service. Derived from data published by the U.S. Dept. of Commerce, Bureau of the Census; American Paper Institute; and American Pulpwood Assn.
Projections: U.S. Dept. of Agriculture, Forest Service.

HISTORIC TRENDS IN U.S. PULPWOOD COSTS

	South				Wisconsin		West Coast
2nd Q.	Roundwood pine $/cord[1]	Roundwood hardwood $/cord[1]	Greenchip pine, clean $/ton[2]	Greenchip hardwood, clean $/ton[2]	Roundwood aspen $/cord[3]	Roundwood jack pine $/cord[3]	Douglas fir chip, export $/bdu[4]
1987	$42.43	$34.10	$23.73	$18.76	$32.50	$47.75	$78.40
1986	41.69	31.57	23.52	17.65	32.00	56.00	79.40
1985	48.97	33.00	25.83	18.32	34.00	58.00	85.80
1984	48.43	32.52	25.96	17.75	32.00	50.85	78.00
1983	45.73	32.01	25.19	17.27	33.00	49.25	79.62
1982	42.86	31.71	22.93	16.20	35.00	54.75	100.75
1981	40.67	30.38	21.45	15.34	34.00	50.25	101.50
1980	40.16	30.77	18.50	14.38	32.65	43.50	113.25
1979	36.71	27.99	15.52	12.73	29.88	41.80	53.00
1978	34.00	26.60	14.30	12.10	27.38	34.46	n.a.
1977	32.20	25.50	13.80	11.60	25.25	35.88	n.a.
1976	31.20	25.50	13.50	11.20	24.75	30.82	n.a.

n.a. = Not available.

1. Average for 11 southern states, delivery to dealer yard (*Timber Mart—South*).
2. Average for 11 southern states, delivery to pulp mill (*Timber Mart—South*).
3. Median prices, delivery to mill (*Wisconsin Forest Products Price Review*).
4. F.A.S. to Japan.

Source: *Pulp & Paper Pricebook.*

INDEXES OF TREND LEVEL SOFTWOOD STUMPAGE PRICES IN THE U.S. BY REGIONS, 1952-76 WITH PROJECTIONS OF EQUILIBRIUM PRICES TO 2030[1-3]

(Indexes of prices/thousand bd ft international 1/4-inch-log rule—1967=100)

					Projected indexes of equilibrium prices[3]				
Region	1952	1962	1970	1976	1990	2000	2010	2020	2030
Northeast	100.0	100.0	100.0	100.0	166.1	185.1	213.6	245.3	279.5
North Central	100.0	100.0	100.0	100.0	154.0	180.9	207.3	238.9	279.0
Southeast	57.8	83.3	111.6	138.9	229.6	280.0	358.0	434.6	526.8
South Central	57.8	83.3	111.6	138.9	230.6	281.6	358.5	434.3	524.7
Rocky Mountains	58.0	83.5	111.5	138.7	473.0	514.4	704.1	859.7	1,045.0
Pacific Northwest:									
Douglas fir subregion (western Washington and western Oregon)	43.8	75.9	118.0	164.2	275.0	228.2	287.4	355.8	430.3
Ponderosa pine subregion (eastern Washington and eastern Oregon)	80.6	93.1	104.4	113.8	300.5	330.6	425.1	500.8	608.1
Pacific Southwest	52.9	80.9	113.6	146.5	300.8	334.7	416.3	490.2	579.9

1. Indexes of prices on a least squares regression line fitted to time series price data for the years 1950-76.
2. Prices are measured in constant (1967) dollars and are net of inflation or deflation. They measure prices changes relative to the general price level and most competing materials.
3. Indexes of the prices which would result from stumpage prices rising enough to maintain an equilibrium between projected timber demands and supplies.

Source: U.S. Forest Service, 1980.

is one of the few federal programs that returns net funds to the U.S. Treasury. In 1987, timber sales from national forests netted the U.S. Treasury $546 million. The National Forest Products Assn. estimated that one billion bd ft of harvested timber produces a $73-million profit for USFS.

Loggers harvested 12.7 billion bd ft, a record high, from the national forests in fiscal year 1987. USFS expects that harvests will exceed 12 billion bd ft in 1988 and 1989, based on forecasts of high domestic demand for wood products. U.S. softwood lumber demand approached a record-high 50 billion bd ft in 1987, which was 6% over the previous year.

The harvest level can be higher than the sale level in any one year because timber may be harvested from purchases made in previous years. In fiscal 1987, there was a 1.4-billion bd ft gap between the 12.7 billion bd ft harvested and the 11.3 billion bd ft sale level. This was the biggest gap since 1973 and the second largest in history. It created log shortages for many lumber and plywood producers who face a dwindling supply of raw materials under contract, and it also contributed to layoffs of loggers and sawmill workers.

PULPWOOD MARKET BY REGION

According to the American Pulpwood Assn. (APA), U.S. paper and board mills consumed 93.9 million cords of pulpwood in 1987, a 2.7% increase over 1986 levels.

U.S. EXPORTS AND VALUE OF WOODCHIPS

	Quantity		Value	Average value	
	short tons	metric tons	$	$/short ton	$/metric ton
1987	2,546,467	2,310,104	$188,459,018	$74.01	$81.58
1986	2,428,333	2,202,935	170,022,023	70.02	77.18
1985	2,317,989	2,102,833	168,813,781	72.83	80.28
1984	2,325,163	2,109,341	164,058,053	70.56	77.78
1983	2,554,176	2,317,097	171,269,000	67.05	73.92
1982	2,860,133	2,594,655	231,140,000	80.81	89.08
1981	3,846,049	3,489,059	314,037,000	81.65	90.00
1980	4,478,234	4,062,584	377,899,701	84.39	93.02
1979	4,498,674	4,081,107	197,846,642	43.98	48.48
1978	3,617,574	3,281,791	156,679,856	43.32	47.74
1977	4,037,901	3,663,103	178,223,078	44.14	48.65
1976	3,946,817	3,580,473	153,001,887	38.77	42.73
1975	3,177,204	2,882,296	115,384,797	36.32	40.03
1974	3,865,780	3,506,958	113,929,564	29.47	32.49
1973	3,480,840	3,157,748	85,727,159	24.63	27.15
1972	2,524,415	2,290,099	57,070,248	22.61	24.92
1971	1,978,731	1,795,065	41,123,878	20.69	22.91
1970	2,418,161	2,193,707	36,634,138	15.15	[illegible].70

Source: Bureau of the Census.

U.S. COMMERCIAL FORESTLAND BY OWNERSHIP, 1981

(000 acres)

Region	Forest industry	Other private	National forests	Other public	All ownerships
South	35,754	134,937	10,955	6,788	188,433
Pacific Northwest	12,349	14,035	31,496	12,879	70,758
North	17,777	121,674	10,121	21,197	170,769
Rocky Mountain	2,096	12,502	36,436	6,732	57,765
All regions	67,976	283,149	89,007	47,595	487,726

Source: U.S. Forest Service.

Between 1950 and 1987, the hardwood proportion of total U.S. pulpwood consumption increased from 13.6% to 30.6%.

A buyers' market for pulpwood existed throughout 1987. Supplies were either sufficient or overabundant, depending on the region. Chip surpluses at some sawmills became so large that storage was a problem. In 1988-89, pulpwood supplies are expected to be tighter.

Southern U.S. APA reported that pulp mills in the South Atlantic region consumed 30.9 million standard cords of pulpwood in 1987, a 5.1% increase over 1986. In the South Central region, mills consumed 33.1 million cords, a 2.9% increase.

A study released in 1987 by USFS entitled "The South's Fourth Forest" revealed that since 1952, softwood inventories in the South have almost doubled and hardwood inventories have increased 53%. These increases occurred despite a 46% rise in timber harvests. The study showed that softwood harvests will temporarily exceed growth and that the inventories will begin a short-term decline. USFS said this is neither an unexpected nor serious aberration.

Part of the decline is due to the fact that larger inventories were created by the Soil Bank program of the 1950s, and most of this wood will likely be harvested over the next five to ten years. Also, the projected inventory increases on industrial lands helped offset nonindustrial private-forest decreases—about 80% of the drop is made up for by industrial gains. Plus, tree growth recovers more quickly due to improved management intensities and higher reforestation rates.

Hardwood inventories will increase in the short term, but they are expected to fall off dramatically due to projected declines in hardwood acreage caused by urban expansion and by the conversion of low-quality hardwood sites to pine production. By 2030, hardwood acreage is expected to decrease by 18.5 million acres. Increased demand for logs by pulp mills is also a major factor in the inventory drop.

USFS also concluded that declines in radial tree growth are not direct indicators of forest productivity or health. The data indicate that normal stand dynamics account for the slowed growth and that acid rain is not the cause.

USFS said that the U.S. South has the highest concentration of forest-industry capacity and employment in the world, and it expects this to grow relative to other regions. The study projected declines in southern forest-industry employment, however, due to improved technology. Opportunities exist (yielding a real rate of return on investment of 4% or more) to significantly increase forest productivity through improved management of 70 million acres of commercial forestland.

U.S. TIMBER HOLDINGS OWNED OR CONTROLLED BY MAJOR U.S. PAPER COMPANIES

Company	**Acreage (000 acres)**
Weyerhaeuser Co.	12,064[1]
Boise Cascade Corp.	6,600
Champion International Corp.	6,474
IP Timberlands	6,300
Georgia-Pacific Corp.	5,580
Great Northern Nekoosa Corp.	3,680
James River Corp.	3,593
Scott Paper Co.	3,200[1]
Louisiana-Pacific Corp.	2,390
Union Camp Corp.	1,740

1. Includes Canadian holdings.

NORTH AMERICAN CHIP EXPORTS TO JAPAN, 1979-86

(000 bdu)

Company	**1986 forecast**	**1983**	**1979**
Weyerhaeuser	415	345	824
Roseburg	360	360	377
Georgia-Pacific	190	180	333
Oregon Chip Terminal	270	250	343
North Coast	150	150	269
Pope & Talbot	95	80	64
Medford Corp.	85	90	111
International Paper	70	15	158
Champion International	50	130	235
Merrill & Rink	50	30	0
Louisiana-Pacific	40	90	148
Cal. Wood Fiber	70	70	0
Others	0	90	501
U.S. total	1,845	1,880	3,363
Fibreco	380	255	80
Weyco Canada	80	50	120
Canfor	15	50	70
Canada total	475	385	310
North America total	2,320	2,265	3,673

CHIP IMPORT FORECAST FOR 1986

(000 bdu)

Company	**1986**	**1983**	**1980**
Taio	600	485	620
Oji	480	400	649
Daishowa	410	385	608
Jujo	205	130	266
Marusumi	175	195	220
Chuetsu Pulp	140	165	257
Honshu	80	150	285
Toyo Pulp	75	80	165

Source: *Paper Business Review.*

USFS concluded that the southern forest-products industry will remain strong and that it will be able to strengthen its position in world markets. Any declines will likely be due to factors other than available timber supply, such as environmental/regulatory restrictions that limit timber availability and/or management, similar to what has occurred in the Pacific Northwest.

Northern U.S. In the Northeast and Great Lakes regions, private landowners control most of the timberland and supply roughly 80% of the timber harvested (primarily hardwoods). The demand for forest products is fairly stable, inasmuch as timber production is not the primary goal of the landowners of this region.

Pulpwood is supplied mostly in roundwood form, with growth far exceeding demand. Mills in the Northeast consumed 7.1 million cords of pulpwood in 1987, about 2% less than they used in 1986. Mills in the North Central region of the U.S. consumed 6.7 million cords, slightly more than they consumed in 1986, APA reported. Despite the demands being made on timber supply by firewood and biomass applications as well as waferboard production, growth is still expected to outstrip demand through 1990.

Pacific Northwest. In the Pacific Northwest, public agencies own slightly over half of the forestland. Unlike other areas of the country, the majority of pulp and paper fiber requirements (roughly 75%) is supplied from residuals from wood-products manufacturing. Pulpwood consumption in the West was equivalent to 16.1 million cords in 1987, a 1% increase over 1986.

Domestic mills in the West compete with Japan for woodchips. Pacific Northwest export prices for Douglas fir chips to Japanese mills increased from $55/bdu in second-half 1979 to a peak of $131/bdu in second-half 1982. From second-half 1986 through first-half 1987, the price was $78.40/bdu. The price in second-half 1987 dipped to $76.70/bdu, mainly because chip prices in both the domestic and export markets were under downward pressure due to strong lumber markets worldwide, which generated a big supply of residual chips. The price for first-half 1988 rose $2.50 to $79.20/bdu f.o.b. vessel. The price for red alder increased by $8.50 to $103.50/bdu. The spruce/pine/fir price was $79.75/bdu. In 1987, the U.S. exported 2.5 million short tons of woodchips valued at about $74.01/ton. Japan bought almost all of these chips.

The second-half 1988 export price for Douglas fir chips

U.S. PULPWOOD PRICES (CHIPS)

(US$/ton to pulp mill; average for 11 southern states)

	Greenchips (clean)	
	Pine	Hardwood
1987		
4Q	$20.12	$17.02
3Q	18.76	14.05
2Q	23.73	18.76
1Q	23.60	18.52
1986		
4Q	22.58	17.55
3Q	22.63	17.49
2Q	23.52	17.65
1Q	24.01	17.71
1985		
4Q	24.04	17.66
3Q	24.29	17.79
2Q	25.83	18.32
1Q	26.22	18.25
Year-end		
1984	26.18	18.03
1983	25.68	17.64
1982	23.83	16.52
1981	21.82	15.01
1980	19.30	14.72
1979	16.71	12.97

Source: *Timber Mart—South.*

U.S PULPWOOD PRICES (ROUNDWOOD)

(US$/cord delivered to mill; median price for Wisconsin)

	Aspen	Jack pine
1987		
4Q	n.a.	n.a.
3Q	$31.00	$46.00
2Q	n.a.	n.a.
1Q	32.50	47.75
1986		
4Q	34.00	n.a.
3Q	34.00	n.a.
2Q	32.00	56.00
1Q	32.00	56.00
1985		
4Q	34.00	58.00
3Q	34.00	58.00
2Q	34.00	58.00
1Q	34.00	58.00
Year-end		
1984	34.00	51.75
1983	34.00	48.50
1982	36.00	57.00
1981	34.00	46.50
1980	33.25	43.50
1979	32.76	45.11
1978	29.75	35.30
1977	25.50	39.50
1976	25.50	31.13
1975	n.a.	n.a.
1974	n.a.	n.a.
1973	20.50	26.00
1972	17.50	22.50
1971	17.25	21.50
1970	17.25	23.50

n.a. = Not available.

Source: *Wisconsin Forest Products Price Review.*

rose $7.50 to $86.70/bdu f.o.b. vessel, and the export price for red alder increased to $111.00/bdu. The price for spruce/pine/fir chips rose $10.25 to $90.00/bdu f.o.b. vessel.

USFS estimated that about 3.35 billion bd ft of timber was damaged in 1987 during the worst fires in the West in 30 years. About 1.7 billion bd ft of wood can be salvaged from forests that suffered the most damage in northern California, Oregon, and Washington. The fires were particularly devastating because they burned young stands of trees, which are less able to resist fires. USFS estimated that without adequate funding more than 500 million bd ft of timber will be lost to insects and disease in fiscal year 1989.

The fires caused a bidding war over green timber in early 1988. Because it expected so many salvage logs to be on the market, USFS cut California's green timber sales down to about 700 million bd ft in 1988 from about 1.6 billion bd ft in 1987. Some sawmills bid so low for green logs that they could not harvest them at a profit. What made the situation particularly difficult in the eyes of the loggers were the numerous appeals filed by environmental groups hoping to stop salvage operations in certain areas.

At least 20% of the charred wood to be sold in California was the subject of appeals, and some sources estimate that 40% of Oregon's timber-sale program has been delayed by appeals made by environmentalists. The longer the delay, the more insect damage occurs. Some observers say the wood may not even be worth salvaging if the delay is too prolonged.

What this means for pulp mills in the Pacific Northwest is that chips could be scarce in second-half 1988, particularly since members of both the International Woodworkers Assn. and the Western Council of Industrial Workers struck many of the region's sawmills in June 1988.

U.S PULPWOOD PRICES (PINE AND MIXED HARDWOOD)

(US$/cord f.o.b. car; state average for Louisiana)

	Pine	Mixed hardwood
1987		
4Q	$51.57	$46.28
3Q	51.06	44.56
2Q	46.56	45.46
1Q	53.49	45.05
1986		
4Q	48.20	41.21
3Q	47.79	34.91
2Q	n.a.	n.a.
1Q	23.68	22.94
1985		
4Q	41.00	35.31
3Q	59.63	41.13
2Q	47.00	36.00
1Q	n.a.	n.a.
Year-end		
1984	48.00	n.a.
1983	n.a.	n.a.
1982	47.08	35.68
1981	44.85	34.83
1980	39.75	31.96
1979	40.80	33.45
1978	35.65	28.65

n.a. = Not available.

Source: *Louisiana Forest Products Quarterly Market Report.*

U.S PULPWOOD PRICES (ROUNDWOOD)

(US$/cord delivered to dealer yard; average for 11 southern states)

	Pine	Hardwood
1987		
4Q	$41.67	$33.96
3Q	41.46	33.73
2Q	42.43	34.10
1Q	41.55	33.40
1986		
4Q	40.91	31.68
3Q	39.92	30.64
2Q	41.69	31.57
1Q	43.68	32.20
1985		
4Q	45.17	31.89
3Q	46.14	31.81
2Q	48.97	33.00
1Q	49.41	33.20
Year-end		
1984	48.75	32.98
1983	47.72	32.43
1982	43.28	31.90
1981	40.99	30.60
1980	43.32	30.95
1979	37.95	30.00

Source: *Timber Mart—South.*

ENERGY USE AND CONSERVATION

Among U.S. manufacturing industries, the pulp and paper industry ranks third overall in energy purchases, after chemicals and primary metals. It ranks first in fuel-oil consumption, third in electricity purchases, third in coal use, and sixth in natural-gas consumption. Spent pulping liquor is the main source of fuel, thanks in large part to the burgeoning number of kraft pulp mills. The second-largest source is bark and woodwaste. Energy costs have moved up to third place, behind fiber and labor, in terms of total cost to the pulp and paper industry. Since 1972, the U.S. pulp and paper industry has cut its total consumption of purchased energy and fossil fuels by about 18%, while pulp, paper, and board production has risen by about 34%.

A survey conducted by the American Paper Institute shows that fossil-fuel and purchased-energy use by the pulp and paper industry per ton of output dropped from 19.1 million Btus in 1972 to 11.4 million Btus in 1987. Self-generated and residue energy sources, such as wood, bark, and spent pulping liquors, accounted for 56.7% of the industry's total energy consumption in 1987, the API reported. This compares with 40.9% in 1972 and 56.0% in 1985. Consumption of fossil fuels and purchased energy dropped by about 18% between 1972 and 1987. Oil use declined 61% from 1972 to 1987. And natural-gas consumption was about 18% below the 1972 level.

Purchased energy. The paper industry buys about $2 billion worth of electricity annually. Electricity now accounts for about 45% of industry energy purchases, although it accounts for only 6.0% of the energy consumed.

Because of the energy crunch of the 1970s, the industry has managed to wean itself of dependence on fuel oil; since 1972, fuel-oil use has declined 55%, although production of pulp, paper, and board has gone up 39%. By 1985, annual consumption of spent pulping liquors was equivalent to about 140 million barrels of fuel oil. According to Ronald Slinn, vice president of API, making a ton of paper requires about 4.5 barrels of oil, which is greater than the amount needed to make a ton of steel.

In 1987, fuel oil accounted for about 7.4% of the energy consumed by the industry, compared with 8% in 1986 and 7% in 1985. Natural-gas use has declined since 1981, but it still accounts for twice as many Btus as fuel oil. Prices declined in the mid-1980s for both oil and natural gas, allowing several mills to defer energy conversion or conservation projects. Obviously, oil consumption reflects

U.S. PULP AND PAPER INDUSTRY'S PURCHASED ENERGY COSTS AS PERCENTAGE OF SHIPMENTS

(million $)

	Purchased energy costs*	Value of shipments	As percentage of shipments
1987p	$4,508	$51,330	8.8%
1986p	4,249	43,990	9.7
1985	4,825	39,172	12.3
1984	5,050	41,385	12.2
1983	4,841	35,645	13.6
1982	4,714	33,636	14.0
1981	4,758	35,116	13.5
1980	4,026	31,758	12.7
1979	3,268	27,991	11.7
1978	2,704	24,027	11.3
1977	2,550	22,302	11.4
1976	2,194	20,976	10.5
1975	1,876	17,822	10.5
1974	1,651	18,530	8.9
1973	933	13,714	6.8
1972	805	11,705	6.9

* Includes electric energy, fuel oil, coal, natural gas, and other fossil fuels.
p = Preliminary.

Sources: American Paper Institute, Bureau of the Census.

changes in oil prices, so OPEC (Organization of Petroleum Exporting Countries) holds the cards that may reveal future consumption patterns.

Consumption of coal has expanded by about 6%/year since the mid-1970s, and this trend is expected to continue. Coal supplies about 11% of the industry's energy needs and ranks as its third-largest energy source.

Cogeneration. The pulp and paper industry leads U.S. industry in cogenerated and self-generated electricity capacity. The industry boasts 7,500 MW of cogeneration capacity, which satisfies about half of its electricity demand. By 1990, about 9,000 MW are expected to be onstream, for an increase of about 20%. This follows a 25% increase between 1982 and 1985. In cogeneration applications filed by the industry in 1984-85, proposed power generation was equivalent to about seven 1,000-MW plants, the API reported.

The only cloud on the horizon is a possible change in the Public Utility Regulatory Policies Act of 1978 (PURPA). This act requires utilities to purchase and distribute cogenerated power produced by nonutilities at no greater cost to consumers than if the utility had generated the power itself. API said it has identified 270 pulp and paper mills, employing at least 155,000 people, in which cogeneration and PURPA play "a significant role in the continued well-being of the facility."

In 1986, about 22,000 MW of cogenerated capacity was operating in U.S. industry; of this, the largest portion, about 35%, belonged to the paper industry. API estimated that another 2,100 MW of potential economical capacity from the paper industry could come onstream by 1990 if PURPA benefits remain in place. (Most of the paper industry's cogeneration facilities are located in the South.) The new tax law, which reduces tax benefits for capital investment, may put a crimp in some of these plans.

In June 1986, Congress held hearings on PURPA, but these did not result in a new law. Utilities want to limit cogeneration by narrowing the criteria that delineate a qualifying facility. There is also disagreement on the method by which avoided cost is calculated (i.e., the cost incurred by the utility to generate or buy from another source the same unit of power that is purchased from the cogenerator). Many states are enacting their own laws that complicate the scene further, and some utilities are becoming increasingly vocal in their opposition to PURPA.

Because of changes in the tax law, electric utilities may be able to charge cogenerators from 30% to 80% more to connect to the grid since these fees are now viewed as taxable income. On the other hand, quite a few utilities welcome new cogeneration plants because they eliminate the need for utilities to build costly new power plants of their own.

If push comes to shove, the paper industry may find an

U.S. PULP AND PAPER INDUSTRY ESTIMATED FUEL AND ENERGY USE—1986, 1983, AND 1972

Source	1986 Consumption (trillion Btus)	% of total	1983 Consumption (trillion Btus)	% of total	1972 Consumption (trillion Btus)	% of total
Purchased electricity	147	6.4%	139	6.5%	93	4.4%
Purchased steam	19	0.8	17	0.8	23	1.1
Coal	344	14.9	305	14.1	225	10.7
Residual fuel oil	189	8.2	204	9.5	447	21.2
Distillate fuel oil	8	0.3	6	0.3	22	1.1
Liquid propane gas	3	0.1	2	0.1	3	0.1
Natural gas	288	12.5	314	14.5	443	21.0
Other purchased energy	3	0.1	3	0.1	2	0.1
Energy sold	(30)	—	(22)	—	(13)	—
Total purchased fossil fuel and energy	970	43.3	968	45.9	1,243	59.7
Hogged fuel, 50% moisture	255	11.1	213	9.9	42	2.0
Bark, 50% moisture	132	5.7	118	5.5	95	4.5
Spent liquor, solids	901	39.2	818	37.7	700	33.2
Self-generated hydroelectric	9	0.4	10	0.5	9	0.4
Other self-generated energy	6	0.3	10	0.5	3	0.2
Total self-generated and waste fuels	1,303	56.7	1,171	54.1	845	40.3
Total energy	2,273	100.0	2,140	100.0	2,093	100.0

Note: Columns may not add to total due to rounding.

Source: American Paper Institute.

ally in environmental groups. Pulp and paper mills need to expend far less incremental energy to make a kilowatt hour of electricity in addition to steam than do large utilities. This reduces the amounts of incremental sulfur dioxide and nitrogen oxides that are emitted per kilowatt hour. Plus, the paper industry is installing new, more efficient boilers that incorporate fluidized bed boilers, coal gasification, and combined cycle systems that cut down on fuel use and emissions.

Energy consumption by grade. Newsprint made mainly from thermomechanical pulp (TMP) requires a high amount of energy per ton of production, which is supplied by purchased electricity and fossil fuels (although some woodwaste may be burned). Unbleached kraft linerboard has lower total energy requirements per ton than newsprint, and about half of this energy may come from burning black liquor. Recycled grades require considerably less total energy per ton to produce than virgin paper and paperboard, but they must rely entirely on purchased fossil fuel and electricity. Purchased-energy requirements for recycled newsprint are lower than for newsprint made from TMP, but they are probably higher for recycled linerboard than for kraft linerboard. Thus, recycled paper and board production does not necessarily conserve energy—at least not from purchased fossil fuels and electricity.

Energy projects. According to the October 1987 issue of *Pulp & Paper Project Report,* the U.S. paper industry has announced that it will install 18 new cogeneration projects. This compares with ten in the previous year. A number of these projects are being financed by outside interests. Five of the new plants are being built, owned, and operated by independent interests. Another trend is the move to new boiler technology, particularly circulating fluidized bed (CFB) boilers. Scott Paper Co.'s Chester, Pa., mill pioneered this technology in the U.S., starting up the first CFB boiler plant in the country (and the world's largest) in 1986. The CFB boiler offers distinct advantages for paper mills because it can burn a wide variety of fuels, including waste coal. At least four of the 18 announced projects include CFB boilers.

One of the more interesting projects is the alternate energy power plant being constructed at Louisiana-Pacific Corp.'s 600-tpd bleached kraft market pulp mill at Samoa, Calif. To be designed and built by Pyrotech Corp. of Kansas City, Mo., the plant is the first commercial installation of an entrained flow, flash pyrolysis system operating on woodwaste. The facility will use conventional technology and Pyrotech's proprietary oil synthesis unit to produce oil from woodwaste. Pyrotech will also use the facility to test the feasibility of upgrading wood oil vapors into high-octane vehicle fuel. The ability to convert wood-derived oil into gasoline-type fuel could have a major impact on the pulp and paper industry in the future.

ENERGY USE PER TON OF PULP, PAPER, AND BOARD PRODUCED

	1987	1986	1972
Energy consumption (trillion Btus)	2,164.8	2,072.8	1,793.0
Total paper and board production (million tons)	79.2	75.3	54.7
Energy use/ton (million Btus)	27.3	27.5	32.8

Source: American Paper Institute.

TRANSPORTATION

Currently, pulp and paper shipments are divided about 60% rail and 40% truck. U.S. rail lines have come under some pressure because of increased competition, both among themselves and from trucking, which is gaining converts from rail. However, rail's relationship with the pulp and paper industry remains strong, said one carrier's pulp and paper director. Rail lines compete mostly among themselves for long-haul cargo. For short distance deliveries and lightweight products such as sanitary tissue, trucks also are competitive.

Railways remain a bargain. The aggressive transportation environment in the U.S. was spurred along by passage of the Staggers Rail Act of 1980, which substantially deregulated the rail industry.

Six years after passage of the act, the Assn. of American Railroads (AAR) said that six positive trends (at least for shippers) have emerged:

- Relatively low increases in railroad freight rates, with declines in some commodities such as grain.
- Only modest increases for coal, the most dominant railroad commodity.
- A reduction in the real (constant dollar) price of railroad transportation on a ton-mile basis.
- Greater rail line sensitivity to the needs of shippers.
- Improvements in railroads' financial stability, though without "surplus" profits.
- Significant gains in efficiency and productivity, with gains passed on to shippers because of the competitive marketplace.

The Interstate Commerce Commission (ICC) approved an inflation-based cost adjustment of 3.5%, although the railroads sought a 5% increase. Still, the hike is above the expected inflation rate of about 2.2%. Rates remain competitive because of competition from trucking, according to Roy Olson, vice president for transportation at the American Paper Institute.

Carloadings of pulp and paper products in the U.S. dropped 1.2% in 1987 to 646,724, down from 654,785 in 1986, according to AAR. The 1987 figure is 15.2% lower than it was in 1984. The pulp, paper, and paperboard industry is, in fact, the primary user of boxcar rail transportation, according to documents filed by API with ICC in support of a boxcar pooling arrangement.

Two separate plans for boxcar pooling, which is designed to make boxcars more readily available for shipping pulp and paper, were approved in 1987 by ICC, but they were not yet operative by second-quarter 1988.

These rulings allow a central management company to coordinate use of boxcars from various railroads that might otherwise be empty on return trips. Supposedly, most of

CARLOADING OF MAJOR U.S. RAILROADS, 1976-87

(000 cars loaded)

Year	Pulp, paper, & allied products	Primary forest products	Lumber & wood products	Total forest products	All rail car-loadings
1987	647	544	419	1,610	20,812
1986	655	532	397	1,584	19,477
1985	712	584	366	1,662	19,574
1984	763	697	372	1,832	20,257
1983	778	739	368	1,885	18,800
1982	829	766	308	1,903	18,498
1981	966	939	397	2,332	21,618
1980	1,060	1,002	469	2,531	22,598
1979	1,097	1,055	597	2,749	23,876
1978	1,094	1,086	649	2,829	23,373
1977	1,103	1,112	675	2,890	23,173
1976	1,101	1,139	670	2,910	23,457

Source: Assn. of American Railroads.

these cars are specially designed for shipping pulp and paper or similar products. The arrangement will not be implemented until a pool manager, possibly AAR, is chosen. API's Olson said that in the meantime carriers have been taking older boxcars out of service.

Because of past inefficiencies in the system, paper companies have reduced their use of the aging boxcars by more than half, relying instead on truck and intermodal rail shipping with containers. The advent of the double-stacking container is particularly advantageous to shippers on transcontinental routes.

The pooling arrangement was supported by API and a number of major paper companies, along with major rail lines including Consolidated Rail Corp. (Conrail), CSX Transportation, and Southern Pacific Transportation Co.

However, the arrangement will be problematic because the boxcars may be used for products other than pulp and paper. The mills require Class A clean boxcars, which means the shipper may have to clean out some cars or reject them until clean ones are available.

One type of rail traffic that has registered gains is piggyback, also known as trailer-on flatcar or container-on flatcar, according to the Dept. of Commerce. This sector was deregulated in 1981. Piggyback traffic rose 40% from 1981 to 1985 and 10% in 1986. It now accounts for more than 15% of all railcar loadings.

U.S. RAILROAD FREIGHT PRICE INDEX

(1984 = 100)

	Pulp, paper, and allied	% change from previous year
1987p	100.7	0.3%
1986	101.0	1.0
1985	100.0	0.1
1984	99.9	4.5
1983	95.6	1.0
1982	94.7	10.8
1981	85.5	11.5
1980	76.7	11.6
1979	68.7	20.5
1978	57.0	5.7
1977	53.9	5.7
1976	51.0	8.3
1975	47.1	13.5
1974	41.5	15.3
1973	36.0	0.3
1972	35.9	1.4
1971	35.4	12.4
1970	31.5	9.0
1969	28.9	n.a.

p = Preliminary.
n.a. = Not available.

Source: Bureau of Labor Statistics.

The intermodal containers are also being used increasingly for purely domestic shipments, says Mike Glen, marketing manager, pulp and paper products, at Union Pacific. Some printing and writing papers already are being moved this way.

The future of the railroads will be tied to the strength of the U.S. economy and to how well many manufacturing industries, including paper, perform. Freight rates overall have declined from 1984 through 1987. They are expected now to remain relatively static or to increase slightly.

Trucking industry still hurting. Since deregulation in 1985, the American trucking industry has been hit by an economic downturn similar to that of the ocean-shipping industry. Another factor putting some carriers out of business is sharply increasing insurance rates.

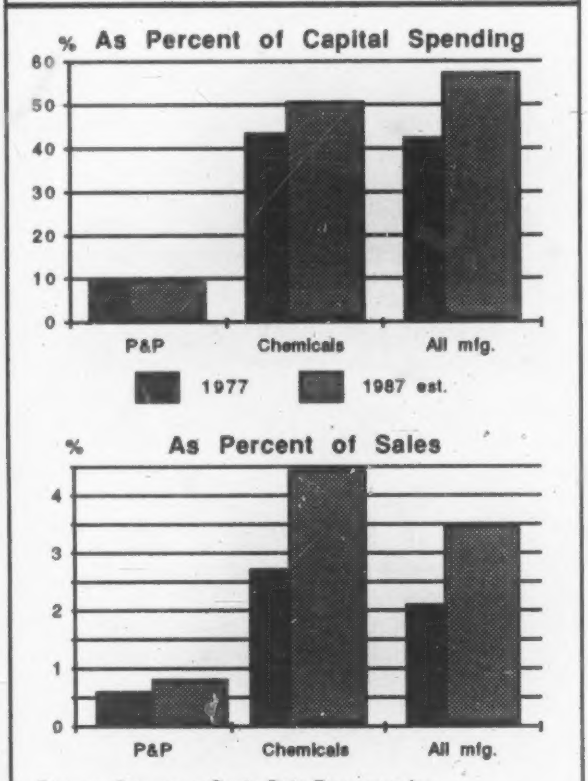
Along with other industry groups, the truckers supported passage of the Motor Carrier Safety Act of 1986. According to the Bulletin of the Truck Trailer Manufacturers Assn., the MCSA sets up these new guidelines for trucking:

- Prohibited drivers from holding more than one license after July 1987.
- Set federal standards for testing and licensing truck drivers by July 1988.
- Established a national clearinghouse for exchange of driver information by July 1989.
- Requires states to be in full compliance by September 1993 or lose highway money.
- Toughened penalties for drug and alcohol abuse on the road.
- Increased federal funding for more roadside inspections from $16 million to $50 million and $60 million in 1991.

Ocean transport declines. Ocean-going carriers—about one-third of all U.S. water-borne transport—have become more important for U.S. wastepaper exports, but shipments of pulp and paper have declined. In New York-area ports alone, about 130,000 long tons (2,240 lb/ton) of pulp and paper were exported via ocean-going vessels in 1980; by 1985, that had fallen to just under 53,000 long tons. In contrast, wastepaper shipments more than doubled from 300,000 long tons in 1980 to almost 691,000 long tons in 1985. Wastepaper is shipped at rates much lower than pulp and paper, and loss of income from the paper sector is indicative of the tough times affecting North American shipping.

Several major North American steamship companies have gone out of business or filed for reorganization under U.S. bankruptcy laws in the last few years. Most of the rest are struggling to gain back market share lost due to some of the same factors causing the enormous U.S. trade deficit. Exports did begin an upturn in 1986, with all pulp and paper products posting a 13.4% increase over 1986. That figure promises to remain about even in 1988.

RESEARCH AND DEVELOPMENT SPENDING



R&D SPENDING PATTERNS
1977 vs 1987

As Percent of Capital Spending

As Percent of Sales

Source: Commerce Dept.; Data Resources Inc.

Besides the work done by paper companies, a significant amount of research into papermaking processes and technologies is performed by supplier companies, as well as by universities and government agencies. Suppliers that perform a substantial amount of research work for the industry include manufacturers of papermaking equipment, felts and fabrics, computer control systems, and chemicals. Academic and government groups are particularly active in paper chemistry and forestry.

Leading research institutes specializing in paper science include the Institute of Paper Chemistry (IPC) in Appleton, Wis.; the U.S. Forest Products Laboratory in Madison, Wis.; and the Pulp & Paper Research Institute of Canada at Pointe Claire, Que.

By 1991, IPC will move from Appleton, where it has been located for over 50 years, to a new facility on the campus of Georgia Institute of Technology. IPC said the main reason for the move was the intellectual stimulation that comes with proximity to a major research facility. Georgia Tech already has a chemical engineering program with a pulp and paper option, which will be enhanced by the presence of IPC.

An IPC spokesman said the mergers that have occurred in the paper industry have caused the number of its dues payers to decrease. In the last couple of years, however, the percentage of pulp and paper production accounted for by its membership relative to total U.S. production has increased. For example, in 1987 Georgia-Pacific Corp. joined IPC. (In 1986, IPC had 48 dues-paying members and 15 associate members, who together provided 51.6% of the funds needed to defray IPC's $12.2 million in expenditures.) Government officials of Atlanta, Ga., are now touting the city as the U.S. headquarters for R&D for the paper industry, given the fact that the Technical Assn. of the Pulp & Paper Industry is also located in Atlanta.

Typical subjects on the research agenda include forest genetics and reforestation techniques, wholetree utilization, hardwood pulping processes, water- and air-quality analysis and control, improved energy use and recovery technology, new types of wet- and dry-forming of paper, computer process control, use of chemicals and fuel from byproducts and waste, and coating and packaging technology.

Industry expenditures. Spending for the paper and allied industries totaled $887 million in 1986, or about 0.9% of sales, according to the National Science Foundation. That compares with average R&D spending of 5.0% of sales for the chemical industry, which competes in some areas with paper, and about 3.5% of sales for all U.S. manufacturing industries.

The paper industry lags in its ratio of R&D spending to total capital expenditures. R&D outlays came to 9.8% of capital spending in 1986, according to Data Resources Inc., compared with 52.8% for the chemical industry and 21.9% for all manufacturing.

Year-to-year increases in the paper industry compare well with other groups, however. The paper industry raised R&D outlays an average of 10.7%/year between 1977 and 1986, compared with 11.5%/year for chemicals and 11.8%/year for all manufacturing.

The Battelle forecast indicates that U.S. industry as a whole continues to support short-term R&D projects and that it is reacting to pressure from foreign competition. The authors noted that R&D expenditures were formerly linked to a favorable business climate, higher sales and profits, and tax policies. However, the stock-market crash, the growing number of mergers, and the unknowns of an election year could put a damper on spending in 1988. Unlike other industries, though, the paper industry entered 1988 after making record profits in 1987, so the prognosis for R&D here is better than the scenario Battelle paints for U.S. industry as a whole.

More spending needed? In the opinion of many industry leaders, U.S. pulp and paper companies are not spending enough on R&D to enable them to compete successfully against other industries or against European and Scandinavian manufacturers in their own arena.

"We must better exploit our nature-given opportunities by building an R&D base that will give us a technological edge," said Edwin A. Gee, former chairman and CEO of International Paper Co. and a former E.I. du Pont de Nemours executive. "This could provide us with a long-term advantage over the chemical industry, based as it is on nonrenewable resources."

David L. Luke III, chairman and CEO of Westvaco Corp., pointed to the need for more emphasis on products. "I think our industry has done a reasonably good job in the application of technology for our processes," he said. "I think we've had a major blind spot in not spending just as much technological effort on our products. Ideally, I'd like to see the industry double its commitment to technology—maintain everything that's being done on process, but match that with an equal amount devoted to innovation of products and development of markets." In 1987, Westvaco spent $54 million on product development and innovation.

Luke also cautioned that the industry can no longer rely on U.S. technology to give it an edge. He noted that in the mid-1970s the combined academic and government levels of forestry research in the southern U.S. totaled about 400 scientist-years annually. Since that time, the level has fallen by about 25% to 300 scientist-years.

Another worry for U.S. mills is that outside engineering firms usually design and build new facilities, and this makes technology transfer to other parts of the world "markedly easy," according to Luke. To the extent that this technology is used in countries where lack of regulation of construction, the environment, and labor costs can produce less-expensive facilities, U.S. mills will be confronted by competitors who can avail themselves of the best technology without being hampered by regulations such as those prevalent in the U.S., Luke warned.

R&D SPENDING BY INDIVIDUAL PAPER COMPANIES

	1987 R&D spending (million $)	% change 1987-86	1987 R&D expenditures (as % of sales)	(per employee)
Kimberly-Clark	$110.50	0.0%	2.3%	$2,957.9
Scott	56.00	18.0	1.4	2,204.7
International Paper	50.00	25.0	0.6	1,098.9
Mead	47.40	42.0	1.1	2,312.2
Weyerhaeuser	46.80	53.0	0.7	1,175.9
Union Camp	39.90	11.0	1.7	2,189.9
James River	36.90	47.0	0.8	1,054.3
Westvaco	27.40	19.0	11.3	1,864.5
Boise Cascade	6.80	–14.0	0.2	337.7
Consolidated Papers	5.00	4.0	0.7	1,162.8
Average	$42.67	20.5%	2.1%	$1,635.9

Source: *Business Week*.

U.S. PAPER INDUSTRY R&D SPENDING vs OTHER MAJOR INDUSTRIES

(million $)

Industry	1983	1984	1985	1986	1985-86 % change
Nonferrous metals	$303	$326	$387	$421	8.8%
Stone, clay, and glass	451	476	486	489	0.6
Chemicals	6,845	7,797	8,352	8,773	5.0
Paper & pulp[1]	674	802	859	887	3.3
Petroleum	2,030	2,177	2,106	1,867	–11.3
Food & beverage[2]	766	1,001	1,042	1,083	–3.8
Textile mill products/apparel	125	139	150	157	4.7

1. 1985 data include allied products.
2. Data from 1984 onward include tobacco.

Source: Div. of Science Resources Study, National Science Foundation.

ENVIRONMENTAL SPENDING AND REGULATIONS

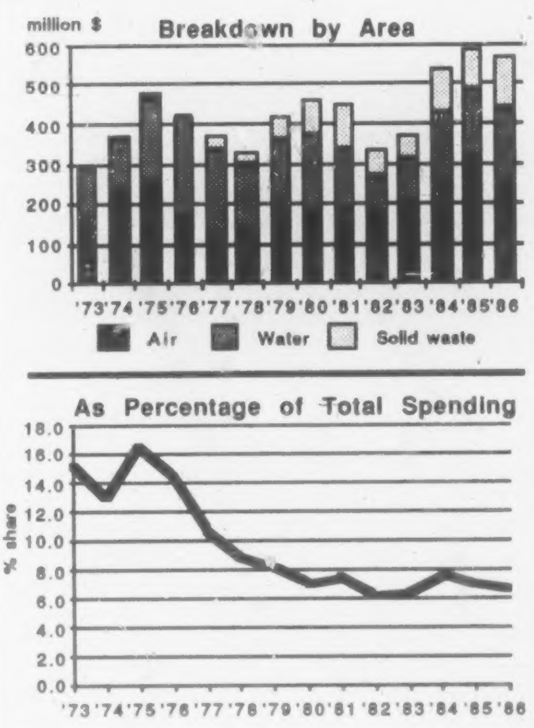
The U.S. pulp and paper industry embarked on a massive cleanup program in the 1970s to comply with newly passed environmental legislation. Environmental outlays claimed more than 20% of total capital spending in the early 1970s, with the percentage running to more than 30% for primary mills. Total dollar outlays peaked in 1976 as deadlines under major air and water legislation were reached, and in recent years, pollution-control spending has been about 5% to 7% of the industry's total capital expenditures.

After a hiatus in which no new federal regulations directly affecting the paper industry were passed, several pieces of pertinent new legislation will soon be implemented. This will increase mill outlays for pollution-abatement equipment, although environmental spending will probably never again approach the levels reached in the early 1970s. Pollution-control spending will remain around the 5% level in 1988.

According to the National Council of the Paper Industry for Air & Stream Improvement Inc. (NCASI), the U.S. paper industry spent about $3.072 billion on air-quality protection between 1966 and 1986. An increasing portion of this money is going toward converting power boilers to burn woodwaste and coal, both of which require sophisticated emission-control technology. About $3.227 billion was spent to control, treat, and dispose of liquid effluents. Expenditures for solid-waste disposal through 1986 amounted to about $462 million, bringing total environmental-protection spending through 1986 to $6.761 billion. Since 1980, these outlays have not exceeded 9% of total capital expenditures.

In 1985, capital outlays for protection of water quality and air quality as well as for solid-waste disposal amounted to about $369 million. Spending in 1986 totaled $348 million, about 5.7% lower than in the previous year. In 1986, about $154 million was spent on water, $151 million was spent on air, and $43 million went to solid-waste disposal. In 1987, pollution-control spending was estimated to total $324 million: $150 million for

CAPITAL SPENDING FOR POLLUTION ABATEMENT



Source: Commerce Dept.

water, $120 million for air, and $93 million for solid-waste disposal. Pollution-control equipment was estimated to account for about 5.3% of total capital expenditures in 1987.

Dept. of Commerce figures, which give a somewhat different picture than NCASI because they cover all paper- and allied-products companies, show a slightly smaller drop-off in 1986 spending. Preliminary figures indicate a 3.4% decline in outlays, from $590 million in 1985 to $570 million in 1986. Spending for air-pollution abatement took the largest share, totaling $260 million, followed by water at $180 million and solid waste at $130 million.

A study by Data Resources Inc. (DRI)/McGraw-Hill predicted that the pulp and paper industry will reduce spending on pollution-control equipment by 3.5% in 1988 to $467 million. DRI reported that most of these dollars will be spent on water pollution-control equipment. According to this forecast, spending on pollution abatement will account for 4.9% of total capital outlays by the paper industry in 1988.

New legislation. The first bill the 100th U.S. Congress passed in 1987 was an $18-billion amendment to the Clean Water Act. The bill sets water-pollution limits through 1994 and provides funds to state and local governments for construction of secondary sewage-treatment plants. It also allocates $400 million toward controlling nonpoint source pollution, such as rainwater runoff from tree farms. More stringent New Source Performance Standards for the discharge of certain chemicals will have the greatest effect on the pulp and paper industry, although these limits are still being determined.

U.S. PAPER INDUSTRY ENVIRONMENTAL PROTECTION SPENDING

(million $)

	Water	Air	Solid waste	Total	% of total capital spending
1987pl	$105	$123	$93	$324	—
1986	80	109	48	237	4.0%
1985	121	175	46	342	7.0
1984	62	130	34	226	6.0
1983	118	149	60	327	6.0
1982	81	214	23	318	9.0
1981	91	120	49	260	6.0
1980	140	190	38	368	9.0
1979	178	158	23	359	12.0
1978	182	149	32	363	16.0
1977	278	148	17	443	19.0
1976	319	216	29	564	29.0
1975	286	341	18	645	30.0
1974	216	296	11	523	31.0
1973	179	162	10	351	34.0

pl = Planned.

Source: National Council of the Paper Industry for Air & Stream Improvement.

Slated for debate in 1988 are revisions to the Clean Air Act. The bill was expected to be completed before year-end 1987, but Congress was unable to accomplish this. The revision brings up the thorny problem of acid rain, which is causing a widening rift between Canada and the U.S. In early 1987, the government of Ontario and eight eastern U.S. states lodged an appeal with the U.S. Supreme Court in an attempt to force the Environmental Protection Agency (EPA) to mandate reductions in sulfur-dioxide emissions. The suit sets a legal precedent because it is the first time a Canadian province and U.S. states allied themselves against the U.S. government. At issue are the estimated 24 million tons of sulfur dioxide discharged by the U.S. annually. Canada estimated that about half its acid rainfall is caused by air pollution generated in the U.S.

In the spring of 1986, President Ronald Reagan and Canadian Prime Minister Brian Mulroney agreed on a plan of attack that called for a five-year, $5-billion program to introduce new coal-burning power plants in the U.S. But the U.S. did little to implement the plan. Accusations flew on both sides of the border. U.S. Interior Secretary Donald Hodel maintained that Canada is complaining about U.S. acid rain in order to increase its energy exports to the U.S.

In spring 1987, Reagan and Mulroney held a summit meeting. The upshot was that the U.S. "agreed to consider" a bilateral accord on fighting acid rain. Canadian officials said the accord would include targets and schedules for reducing cross-border flows of acid-gas pollution.

Besides this half-hearted effort, three bills were pending in Congress that, if enacted, would limit sulfur-dioxide emissions. While there was strong support within the U.S. Senate's Environmental Control Committee for acid-rain controls, states with industries that produce acid rain posed potential political problems. In his 1988 budget, Reagan allocated $500 million to fund new acid-rain research programs, but it is unclear if this will get through Congress.

EPA has also given notice that it intends to list chloroform as a hazardous air pollutant under Section 112 of the Clean Air Act. The American Paper Institute and the National Forest Products Assn. have estimated that this could cost the paper industry over $250 million annually in pollution-control expenditures. The pulp-bleaching process generates about 25% of U.S. chloroform emissions, according to EPA. API and others said the risks posed by chloroform, which is a carcinogen, are exaggerated by EPA. NCASI reported that a major study of the bleaching process is being organized, including a study of chloroform emissions. Studies of wet scrubber control technology in bleach plants that emit chlorine and chlorine dioxide are being broadened to include chloroform.

Three federal agencies—EPA, the Occupational Safety & Health Administration (OSHA), and the Consumer Product Safety Commission—investigated the role of formaldehyde in causing cancer. This resulted in a decision to have OSHA implement stricter limits on formaldehyde during 1988. The new regulation will lower the allowable exposure to formaldehyde to 1.0 ppm from 3.0 ppm over an eight-hour day. It will also set a maximum short-term exposure level of 2.0 ppm during a 15-min period. Employers will be required to monitor exposure, train employees, and place workers under medical surveillance when formaldehyde levels reach 0.5 ppm over an eight-hour period.

A study conducted in 1986 by the United Paperworkers International Union (UPIU) on formaldehyde use in the paper industry indicated that a permissible exposure limit of 1.0 ppm has already been attained by most companies that use formaldehyde. UPIU concluded that 90% of the mean exposures in paper companies, 90% in paperboard and boxboard plants, 75% in corrugated container plants, and 50% in specialty products plants are reported to be below the 1.0-ppm level. UPIU is especially concerned, however, with paper dusts that carry formaldehyde, estimating that at least 60% of formaldehyde exposures occur via particulates.

Dioxin discharge limits? The biggest environmental issue to dog the U.S. pulp and paper industry in years was the discovery in 1987 of low levels of dioxin in sludges from kraft pulp mills that use the chlorine bleaching process, of which there are about 85 in the U.S. (20% of all U.S. pulp mills). Should stringent limits be placed on dioxin discharge, it will be one of the most costly regulations the industry has had to face in a long time.

Results of a study begun by EPA in 1983 and made public in 1987, called the National Dioxin Study, found more dioxin than was expected in fish downstream from some pulp and paper mills. EPA will continue to monitor this situation. The environmental group Greenpeace alleged that EPA agreed to consult API before releasing the report. A court order will require EPA to answer questions under oath about this and the joint five-mill study (described below) in 1988.

In 1987, API and EPA conducted a joint study of five bleached kraft pulp mills, the results of which indicated that at least three of the five mills discharged low levels of dioxin into a receiving stream. The chlorine in the process is believed to cause the problem. Currently, no federal regulation limits the discharge of dioxin. Although the

ENVIRONMENTAL LEGISLATION AFFECTING THE PULP AND PAPER INDUSTRY SINCE 1970

1970

AIR QUALITY STANDARDS ACT
(Clean Air Act)
(P.L. 91-604)
WATER QUALITY IMPROVEMENT ACT
(P.L. 91-224)
RESOURCE RECOVERY ACT
(P.L. 91-512)
OCCUPATIONAL SAFETY & HEALTH ACT
(P.L. 91-596)

1972

WATER POLLUTION CONTROL ACT AMENDMENTS
(P.L. 92-500)
ENVIRONMENTAL PESTICIDE CONTROL ACT
(P.L. 92-516)

1973

CLEAN AIR ACT AMENDMENTS
(P.L. 93-15)

1974

SAFE DRINKING WATER ACT
(P.L. 93-523)
CLEAN AIR ACT AMENDMENTS
(P.L. 93-319)

1976

TOXIC SUBSTANCES CONTROL ACT
(P.L. 94-469)
RESOURCE CONSERVATION & RECOVERY ACT
(P.L. 94-580)

1977

CLEAN AIR ACT AMENDMENTS
(P.L. 95-95)
CLEAN WATER ACT AMENDMENTS
(P.L. 95-217)

1978

RESOURCE CONSERVATION & RECOVERY ACT AMENDMENTS
(P.L. 95-509)

1980

SOLID WASTE DISPOSAL ACT
(P.L. 96-482)
COMPREHENSIVE RESPONSE, COMPENSATION & LIABILITY ACT (SUPERFUND)
(P.L. 96-510)

1986

SUPERFUND LAW
SAFE DRINKING WATER ACT AMENDMENTS

1987

CLEAN WATER ACT AMENDMENTS

1988

CLEAN AIR ACT AMENDMENTS

long-term effects of dioxin on people have not been fully documented, dioxin has been shown to be highly toxic to laboratory animals in very small amounts. For this reason, it is possible that EPA may impose discharge limits on dioxin in 1988.

Pressure mounted in 1987 when several major newspapers reported that an internal investigation by API revealed trace amounts of dioxin in paper products made using bleached kraft pulp. The existence of the study was publicized when internal API memos were leaked to Greenpeace.

In early 1988, API released the results of this study, entitled Assessment of Potential Health Risks from Dermal Exposure to Dioxin in Paper Products, saying it proved that trace levels of dioxin found in paper products are safe for consumers and mill workers. API said the actual concentrations of dioxin in the products tested is much less than one in one million parts. Among the products tested were printing/writing papers and some personal-care products.

In April 1988, EPA and API signed an agreement to initiate a joint dioxin-testing program at 103 mills in the U.S. Samples of sludge, wastewater, and bleached pulp will be taken at U.S. mills that bleach chemical woodpulp with chlorine or chlorine derivatives. A more thorough study will be made of 25 mills. The testing program is expected to take one year, and the mills will pay for the tests. The Food & Drug Administration is expected to use the data generated by the study to begin formulating some risk assessments.

Environmental groups are calling for a ban on bleaching processes that use a lot of chlorine, and they are advocating the installation of oxygen delignification systems instead. Many mills in Sweden and Fed. Rep. Germany already use this process because of stricter environmental regulations. As of April 1987, nine of the 15 bleached pulp mills in Sweden were using oxygen delignification prebleaching. The Swedish government has set allowable total organic chloride discharge limits at 2.0 kg/ton, a reduction of 40% since 1980. Sweden's Ministry of the Environment is also considering banning the use of bleached fluff pulp in disposable baby diapers, and it may expand the ban to toilet paper and other personal-care products.

Preventing Bhopal. Of major importance to U.S. industry as a whole is the Superfund law passed in October 1986. In this context, the Emergency Planning & Community Right to Know Act is designed to reduce the chances of chemical accidents, such as that which occurred in Bhopal, India. Some of the new regulations cover chemicals frequently used by the paper industry. The legislation defines three categories of chemicals subject to reporting or notification: extremely hazardous substances, hazardous chemicals, and toxic chemicals. Some chemicals used by the paper industry fall into the first category, including chlorine, ammonia, formaldehyde, methyl mercaptan, hydrogen sulfide, sulfur dioxide, and sulfuric acid. Companies must notify both state and local bodies of accidental spills or releases above certain limits.

By May 17, 1987, mills had to give notification if they stored onsite over a "threshold planning quantity" of the chemicals. These quantities are as follows: chlorine gas, 100 lb; ammonia gas, 500 lb; sulfuric acid, 1,000 lb; and formaldehyde gas, 500 lb.

The hazardous-chemical category covers a plethora of chemicals designated as hazardous by the OSHA Hazard Communication Standard. Mills had to submit material safety data sheets on each hazardous chemical to the local emergency planning commission, fire department, and state emergency-response commission by Oct. 17, 1987. By Mar. 1, 1988, mills had to submit an emergency and hazardous-chemical inventory form detailing the maximum and daily average amounts of these onsite chemicals and their locations.

The third category, toxic chemicals, contains over 340 chemicals and chemical categories. Some paper-industry chemicals on the list of toxic chemicals include ammonia, chlorine, chlorine dioxide, chloroform, formaldehyde, PCBs, sulfuric acid, and titanium dioxide. Facilities that make, process, or use these chemicals over specific levels will have to submit annually a "toxic chemical release form" to both EPA and the state. The form will detail maximum amounts of toxic chemicals present at the facility during the year, methods of treatment and disposal, and estimates of the amounts released into the air, water, and land. The first toxic chemical release form had to be submitted by July 1, 1988.

PAPER MACHINERY

As of Jan. 1, 1987, the U.S. no longer imposes tariffs on imported pulp and paper machinery. The U.S. Dept. of Commerce put imports of pulp and paper machinery for 1987 at $562 million. Imports in 1988 are estimated to reach $570 million, an 8.6% increase over 1987. The 1987 paper machinery trade deficit was $253 million, and the 1988 deficit is predicted to be $280 million. The U.S. last ran a trade surplus in paper machinery in 1982, when exports topped imports by $109 million.

The flip side of the issue, exports, does not give cause for relief. In 1986, exports of pulp and paper manufacturing machinery grew by 7.2% to about $269 million, the Dept. of Commerce reported. In 1987 exports amounted to $308.6 million. U.S. suppliers are still subject to tariffs elsewhere, such as Finland, Canada, and Switzerland. Should legislators in both Canada and the U.S. approve the proposed free-trade agreement between the two countries, Canada's 9.2% tariff on U.S. paper machinery would be phased out over a five-year period.

The Dept. of Commerce reported that Wisconsin accounts for one-third of all U.S. paper machinery shipments. Massachusetts is second with 11%. Pennsylvania and New York follow with 10% and 9%, respectively.

The strong dollar hurt overseas sales for U.S. manufacturers in the mid-1980s, and severe economic conditions have prevented new investments in many Latin American countries that have traditionally been strong markets for U.S. machinery. The value of the dollar has since moved to favor the U.S. supplier, however, and

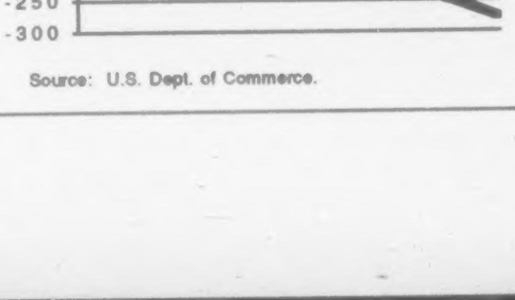
AD VALOREM TARIFFS CHARGED BY VARIOUS COUNTRIES ON IMPORTS OF PAPER AND BOARD MANUFACTURING MACHINERY

(Brussels Tariff Nomenclature 84-31)

Country	Current
United States[1]	Duty-free
Finland	5.10%
European Community	3.80%
Canada	9.20%
Japan	
Paper	3.90%
Board	3.40%
Brazil	
If PM is made in Brazil	40.0% + 5% V.A.T.
PM not available in Brazil	20.0% + 5% V.A.T.

[1] TSUS 66800.40 except for certain codes with tariffs of 2.4%, (i.e., dryers and other specialized parts).

U.S. PAPER MACHINERY BALANCE OF TRADE



Source: U.S. Dept. of Commerce.

economies appear to be improving in the important Latin American market.

During the first quarter of 1988, exports of paper machinery amounted to $84.345 million, a 42% jump over year-earlier levels, the Dept. of Commerce reported. Canada accounted for $25.2 million of this total. Imports rose 29% to $161.808 million. About 30% of these imports came from Fed. Rep. Germany, 18% came from Finland, and 9.8% came from Canada. Also during the first quarter, Switzerland imported $14.6 million worth of machinery, and Brazil imported $12.4 million. Trade with Japan remained brisk; the U.S. imported $11.8 million worth of machinery and exported $4.6 million.

In 1987, Congress considered a tariff bill that would establish standard international import and export codes for all goods traded worldwide. The new harmonized trading system will probably not go into effect until late 1988 because Congress never voted on it in 1987 and because President Ronald Reagan vetoed the trade bill in early 1988. While the bill would change the duty rates charged for some goods, it was not expected to alter the duty-free status of paper and paperboard manufacturing machinery.

It is not exactly accurate to refer to imports of paper and board manufacturing machinery as "duty-free." This would be true if entire paper machines were imported in one piece. Because they are too large, the machines arrive in sections, and some of the components are not duty-free. Thus, importers of paper machines often end up paying some duties.

Another wrinkle is Reagan's entry processing fee established on Oct. 21, 1986, as part of the Omnibus Budget Reconciliation Act. A fee of 0.22% was effective from Dec. 1, 1986, through Sept. 30, 1987, when it was reduced to 0.17%. Expiring Sept. 30, 1989, the levy applies to all imports and raises machinery costs regardless of what it is called.

Where the money is. The reluctance of pulp and paper companies to start up greenfield mills has turned machine rebuilds into equipment manufacturers' bread and butter. About 70% of the equipment now made in the U.S. is for rebuilds. U.S. companies have one foot in the door of this market because in many cases they are providing parts for a U.S.-made machine that is already in place. Over half of the paper and paperboard machines in the U.S. were installed before 1971, and 10% have been around since 1950.

In constant dollars, product shipments of paper machines were expected to fall 2.2% in 1987 to $990 million, a 17% decline from 1982. Equipment suppliers are hamstrung by the long lead time for ordered equipment, which has delayed their rebound from the 1982-83 recession.

Living in the global village. U.S. equipment suppliers have to not only contend with machinery from traditional importers, such as Finland, Canada, and Fed. Rep. Germany, they also face increased imports from Brazil, Japan, Italy, and other newcomers. To complicate matters further, they sometimes compete with even their own overseas operations. Many companies, both U.S. and European, have established foreign manufacturing subsidiaries and licensees to take advantage of cheap labor or proximity to major markets. Such moves tend to blur the distinctions between countries of origin. Thus, a contract for a new paper machine to be installed in Canada was awarded in 1987 to the Brazilian subsidiary of a European manufacturer. And earlier in the decade, a new paper machine installed in the U.S. was reportedly supplied by the Japanese licensee of a U.S. manufacturer.

Imports of machinery from Brazil amounted to $42.84 million in 1987, an increase of 4.4% since 1985. Fed. Rep. Germany claims the largest stake in the U.S. market—about 33% of U.S. paper machinery imports ($183.6 million) came from this country in 1987. Switzerland was second at $69.6 million, followed by Canada, $57.4 million; Japan, $48.2 million; Sweden, $39.6 million; and Finland, $37.0 million.

Canada is still the best customer of U.S. paper machinery manufacturers, buying $99.6 million worth (or 32%) of all U.S. machinery exports in 1987. Japan bought $20.5 million worth, followed by the U.K., $19.8 million; Fed. Rep. Germany, $15.2 million; Mexico, $14.3 million; and Australia, $12.7 million.

Learning to adapt. U.S. suppliers should expect more of the same in the next five years. Product shipments are expected to climb about 2.5%/year in constant dollars, but this will not return the industry to the profitability it enjoyed in 1982. This conservative growth scenario hinges on a healthy level of capital investment at the mill level, in terms of both rebuilds and new installations. Suppliers of process control equipment, particularly millwide systems, will continue to have strong sales as process automation

CATEGORIES OF PAPER MACHINERY*

Wood preparation. Machinery involved from the receipt of rough wood at the mill yard to delivery of prepared wood or chips to the pulp mill.

Pulp manufacturing. All equipment required for processing wood or other raw fiber into pulp for delivery to stock preparation, including chemical recovery equipment.

Pulp refining. Processing of pulp fiber for delivery to the paper machine(s).

Paper and paperboard manufacturing. From the headbox through the machine winder.

Finishing. Supercalenders, winders, sheeters, and sheet and roll wrapping equipment.

Converting. Coaters, laminators, embossers, saturators, corrugators, and fabricating equipment . . . boxes, cores, bags, envelopes.

* Based on classification scheme proposed by the Pulp & Paper Manufacturers' Assn. for use by the Bureau of Census in collecting statistical information.

MANUFACTURERS BY COUNTRY OF NEW PAPER MACHINES STARTED UP IN U.S., 1977-87

(Number of machines)

Manufacturer	1977/78	1979/80	1981/82	1983	1984	1985	1986	1987	Beyond 1987	Total
Allis-Chalmers (U.S.)	1	—	—	—	—	—	—	—	—	1
Beloit (U.S.)	4	12	6	1	2	1	4	2	1	33
Black Clawson (U.S.)	—	—	—	—	—	—	—	—	—	0
Manchester (U.S.)	—	1	—	—	—	—	—	1	—	2
Dominion (Canada)	—	—	—	—	—	—	—	—	—	0
Holder (U.K.)	1	—	—	—	—	—	—	—	—	1
KMW (Sweden)	—	1	1	—	—	—	—	—	—	2
Sulzer-Escher Wyss (Fed. Rep. Germany)	—	—	—	—	—	1	1	—	—	2
Tampella (Finland)	1	2	3	—	—	1	—	—	—	7
Valmet (Finland)	—	1	5	1	—	—	1	—	2	10
Voith (Fed. Rep. Germany)	2	2	1	—	1	1	2	1	2	12
Total U.S.	5	13	6	1	2	1	4	3	1	36
Total foreign	4	6	10	1	1	3	4	1	4	34

Source: *Pulp & Paper Project Report.*

PULP & PAPER MACHINERY INDUSTRY (SIC 3554) SHIPMENTS, EXPORTS, AND IMPORTS, 1972-88

(million $)

				Ratios	
Year	Shipments	Exports	Imports	Imports/ new supply[1]	Exports/ shipments
1988e	n.a.	$290	$570	n.a.	n.a.
1987	n.a.	309	562	n.a.	n.a.
1986	$1,296	269	511	0.208	0.233
1985	1,152	251	411	0.263	0.217
1984	1,130	259	301	0.210	0.229
1983	1,021	203	210	0.171	0.199
1982	1,199	316	207	0.147	0.263
1981	1,177	351	273	0.188	0.299
1980	1,177	318	242	0.171	0.271
1979	1,017	233	246	0.195	0.229
1978	799	192	184	0.188	0.240
1977	698	184	151	0.178	0.263
1972	381	78	55	0.126	0.203

e = Estimate.
n.a. = Not available.
1. New supply = product shipments + imports.

Source: U.S. Dept. of Commerce, International Trade Administration, Edward Abrahams.

continues to grow. Suppliers of specialized machinery will also enjoy some good years. Those that manufacture coaters, supercalenders, and winders will benefit from increased demand for coated papers.

Export growth will be healthy, but it will not reverse the trade deficit, especially in light of the duty-free status that machinery imports enjoy. Scandinavian and northern European suppliers will continue to command the U.S. import market, while relative newcomers are also expected to increase their shares.

Major suppliers. Suppliers of paper machinery have not escaped the merger activity rampant in most industries. This is one of the reasons why employment in the industry has fallen off; it is expected to slip below 14,000 before 1990. In 1986, Beloit Corp. (the largest domestic U.S. paper machine supplier) was bought out by Harnischfeger Corp. And in early 1987, Harnischfeger found itself fending off an unsolicited buyout bid from a group of private investors led by Columbia Ventures Inc. of Miami, Fla. Black Clawson Co., the second-largest U.S. pulp and paper machinery manufacturer, remains independent.

Two of the top pulp machinery manufacturers were combined in 1986. Combustion Engineering Inc. purchased the Sprout-Waldron Div. of Koppers Corp. and merged it with its C-E Bauer unit, creating C-E Sprout-Bauer. In early 1987, Combustion Engineering extended its reach into the paper-machinery market with the purchase of AccuRay Corp., one of the largest U.S. makers of process control equipment. Also in early 1987, Beloit and Measurex Corp., the other large process control supplier, formed a sales alliance.

Among foreign suppliers, Sunds Defibrator (a subsidiary of Svenska Cellulosa AB of Sweden) announced late in first-quarter 1988 that it will acquire Rauma-Repola Oy's chemical pulping division for an undisclosed amount. The division will be called Sunds Rauma Oy. The agreement calls for Rauma to get one-third of the share capital in Sunds. If the merger is approved by Swedish and Finnish authorities, Sunds will be equally owned by Swedish company Svenska Cellulosa and Finnish companies United Paper Mills and Rauma-Repola. In 1987, Sunds tried to buy the Impco Div. of Ingersoll-Rand of the U.S., but that deal fell through when the Federal Trade Commission expressed concern about the merger and Ingersoll decided not to pursue the discussions.

Early in 1986, Valmet Oy of Finland and KMW AB of Sweden formed Valmet-KMW AB to manufacture paper machinery. The company is based in Sweden and is 75% owned by Valmet and 25% owned by KMW. Valmet produces paper machines for newsprint and fine papers, while KMW manufactures tissue machines, kraft packaging paper machines, and pulp drying machines. Valmet also acquired some of Wärtsilä AB's facilities in the U.S.

In May 1988, Valmet integrated Valmet-Dominion, Valmet-KMW, and Valmet-Appleton into a single North American division to improve its service to pulp and paper customers. At about the same time, Valmet was given permission by the Finnish government to sell up to 40% of its equity shares. (Valmet is state owned).

More recently, Bird Inc. of the U.S. and Sulzer Escher Wyss of Ravensburg, Fed. Rep. Germany (a unit of Sulzer Group of Switzerland), entered into a multimillion dollar joint venture, creating Bird Escher Wyss. The venture will sell pulp and paper machinery and systems of both companies in North America, and it will develop new systems for sale worldwide.

CANADA

INDUSTRY STRUCTURE

There are currently just over 100 corporate entities manufacturing pulp, paper, or paperboard in Canada. These companies operate 108 paper and board mills, which may or may not have pulp-producing capacity, and 34 market pulp mills. (Companies with combined pulp and paper capacity of 1,000 tpd or more are listed in the "Major firms" section of Company Profiles.)

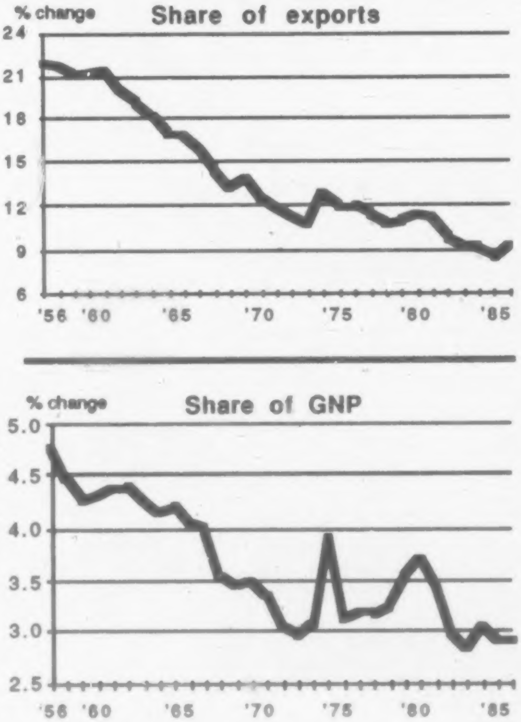
A total of 140 separate establishments were listed by Statistics Canada for the year 1985 in its annual "Pulp and Paper Industries" census of manufacturers, two less than the previous year. During the past 35 years, this figure has fluctuated, rising from 123 facilities in 1950 to a high of 147 facilities in 1976. The census includes those establishments primarily engaged in manufacturing pulp, paper, paperboard, and building and insulation board.

Approximately 58,800 production and related workers at these sites were counted in the 1985 census. These employees recorded just over 126 million manhours during 1985, for which they were paid wages slightly more than C$2 billion.

Total industry employment for 1985 was 77,562, with wages and salaries totaling $2.81 billion. Pulp and paper mill workers earned an average of $668.93/week in 1985, the highest of any major Canadian industry. The next closest group was smelting and refining workers, who made just under $667/week.

The most significant province, in terms of number of mill sites and total output, is Quebec. Its mills produced 6.4 million tons of paper and paperboard (excluding building boards) in 1985 at 57 sites. Estimated production from its closest rival, Ontario, with 36 mill sites, totaled 3.8 million tons for the same period. British Columbia ranked third, with an estimated 2.5 million tons at 24 sites, while the total from the remaining provinces was just over 2.0 million tons.

LONG-TERM DECLINE IN PULP AND PAPER'S CONTRIBUTION



Source: Statistics Canada

LEADING CANADIAN FIRMS

(1987 sales of companies with capacities of 1,000 tpd or higher)

Rank	Company	1987 sales	Pulp capacity (rank)	Pulp capacity (tpd)	Paper/board capacity (rank)	Paper/board capacity (tpd)
1.	Noranda Forest Inc.	4,246,500,000	8	2,945	7	2,140
2.	MacMillan Bloedel Ltd.	3,134,500,000	2	5,940	2	4,900
3.	Abitibi-Price Inc.	2,988,000,000	1	8,190	1	7,167
4.	Domtar Inc.	2,568,000,000	5	3,522	4	4,086
5.	Consolidated-Bathurst Inc.	2,261,430,000	4	5,045	5	3,904
6.	CIP Inc.	1,934,000,000	3	5,920	3	4,865
7.	British Columbia Forest Products Ltd.	1,400,427,000	6	3,440	9	2,044
8.	Canfor Corp.	1,244,900,000	14	2,127	21	295
9.	Crown Forest Industries Ltd.	1,029,200,000	11	2,285	10	1,520
10.	Repap Enterprises Corp. Inc.	927,000,000	12	2,265	13	1,450
11.	Great Lakes Forest Products Ltd.	752,221,000	7	3,120	12	1,460
12.	Weldwood of Canada Ltd.	741,035,000	19	945	—	—
13.	Eddy Paper Co. Ltd.	659,000,000	22	900	17	1,063
14.	Cascades Inc.	527,732,000	15	1,431	14	1,413
15.	Quebec & Ontario Paper Co. Ltd.	513,712,000	13	2,255	8	2,050
16.	Donohue Inc.	510,054,000	9	2,868	16	1,185
17.	Reed Paper Inc.	366,000,000	16	1,175	15	1,255
18.	Eurocan Pulp & Paper Co.	318,000,000	18	950	18	1,010
19.	Western Pulp Limited Partnership	258,213,000	17	1,050	—	—
20.	Paperboard Industries Corp.	203,749,000	—	—	11	1,465
—	Kruger Inc.	n.a.	10	2,656	6	2,791
—	Stora Kopparbergs Bergslags AB	n.a.	20	915	19	788
—	Daishowa International	n.a.	21	903	20	390

Source Compiled from data in Company Profiles section.

TEN LEADING CANADIAN MANUFACTURING INDUSTRIES, 1984*

	Number of employees	Wages, salaries (C$000)	Selling value of shipments (C$000)
Pulp and paper mills	60,203	$1,903,332	$13,014,250
Motor vehicle parts, accessories	12,408	444,308	3,601,620
Sawmills, shingle & planing	49,358	1,284,415	6,264,854
Other machinery/equipment	21,606	710,606	4,382,732
Primary steel industries	34,388	1,169,468	7,094,649
Motor vehicle industry	41,732	1,379,326	20,755,578
Meat & poultry products	23,780	559,651	8,277,238
Dairy products industries	8,279	188,070	3,532,925
Industrial chemicals industries	5,775	208,189	4,296,080
Refined petroleum products	5,717	241,613	22,958,432

* Latest available.

Source: *Statistics Canada.*

Quebec also led in output of woodpulp in 1985, producing 6.4 million tons. In this category, however, British Columbia came in a close second with almost 6.0 million tons. Ontario finished third with 4.4 million tons, followed by the remaining provinces with 3.8 million tons.

By far, the largest segments of the Canadian industry are those producing newsprint and woodpulp (including market pulp). Canada has historically been the world's largest producer of newsprint, with production for 1985 almost twice that of its closest rival and largest customer, the U.S. This ranking is reversed in the case of woodpulp production, with the U.S., the world leader, producing more than twice the amount of pulp as Canada. These two commodities represented between them almost 77% of total estimated 1985 pulp, paper, and board shipments for the Canadian industry.

Similarly, exports are far more important to the Canadian industry than domestic shipments, representing 76% of all shipments in 1985. Pulp and paper exports had been Canada's most important generator of export revenues until 1983, when they were eclipsed by the automobile industry, which remains number one. Industry dollar revenues for 1985 totaled over $10 billion, as compared with almost $116 billion in total Canadian export revenues.

The pulp and paper industry was, however, the largest Canadian manufacturing industry in terms of wages and salaries paid, total employment, and value added by manufacture. Pulp and paper was third, behind the petroleum and auto industries, in terms of the selling value of factory shipments for 1983 (the latest year available).

Despite this apparent healthiness, the importance of the pulp and paper industry to the Canadian economy in general and to Canadian exports in particular has fallen over the last 35 years. Pulp and paper production in 1985 represented just 2.9% of the gross national product, down from 5.3% in 1950. Industry exports as a percentage of foreign trade dropped even more significantly, falling from 22.9% in 1950 to 8.7% in 1985.

PULP, PAPER, AND BOARD MILLS IN CANADA

(Number of mill sites)*

	Paper/ board mills[1]	Pulp mills
Alberta	4	6
British Columbia	11	24
Manitoba	4	4
New Brunswick	7	10
Newfoundland	3	3
Nova Scotia	4	5
Ontario	35	25
Quebec	57	50
Saskatchewan	0	1
Total	125	128

* One or more pulp mills may be located at the site of a paper/ paperboard mill. Total pulp mills shown.

[1] Molded pulp products not included in tabulations.

Source: *1988 Lockwood-Post's Directory.*

PRODUCTION, EXPORTS, AND IMPORTS

Production at Canadian mills began to recover in 1983 from the off years of 1980-82, and that rebound continued strongly for most grades in 1984. After some more weakness—although not a downturn—in 1985, production picked up again in 1986 and 1987, setting new records in both years. Healthy economic conditions and upbeat short-range forecasts for major markets make it likely that 1988 will see new highs being reached.

The Canadian industry produced just under 13.5 million metric tons of paper and board in 1979 and about 100,000 tons less in 1980. Output topped 13.6 million tons in 1981 only to tumble by more than one million tons the following year. In 1983, production returned almost to the 1980 level, capping the year at 13.4 million tons.

In 1983, output showed the first signs of the recovery that would boost production to 14.2 million tons by the end of 1984. In the two years that followed, levels moved up even higher. At year-end 1986, the Canadian industry had reason for jubilation as production set an all-time record of just over 15 million tons, a 5.5% increase from the previous year. That growth continued in 1987, when over 16 million tons were produced, a 5% increase from 1986.

Newsprint on a roll. The recovery in Canada's important newsprint sector began in 1983 and, allowing for a slight correction in 1985, has mirrored the rise in the rest of the paper and board industry. The greatest growth in year-to-year levels occurred from 1983 to 1984, when production expanded by 6.2%. This performance was not to be repeated during the next year, however, when production experienced an 0.3% decline from 1984's record levels due to softer markets and the impact of the strong U.S. dollar. From 1985 to 1986, the trend reversed again as newsprint production posted a 3.2% gain, finishing the year at almost 9.3 million tons. In 1987, further improvement was made, and production rose 4% to nearly 9.7 million tons.

Operating rates for the newsprint industry have been

CANADIAN PRODUCTION OF PULP AND PAPER/PAPERBOARD BY PROVINCE, 1986

(000 metric tons)

Pulp		Paper/paperboard*	
1. Quebec	6,510	1. Quebec	6,600
2. British Columbia	6,509	2. Ontario	3,930
3. Ontario	4,441	3. British Columbia	2,600
4. Others	3,967	4. Others	2,210

*Excludes building board.

Source: Canadian Pulp & Paper Assn. estimates.

CANADIAN DOLLAR VALUE IN U.S. DOLLARS

(average for year)

Year	C$ = US$	Year	C$ = US$
1988*	$0.771	1979	$0.854
1987	0.754	1978	0.877
1986	0.720	1977	0.938
1985	0.733	1976	1.014
1984	0.733	1975	0.982
1983	0.812	1974	1.022
1982	0.811	1973	1.000
1981	0.834	1972	1.000
1980	0.855		

*First quarter.

Source: *Pulp & Paper Pricebook.*

steadily climbing since their slump in 1982-83, breaking the 90% barrier in 1984 and 1985. Another rise to 94% occurred in 1986, and in 1987, the industry ran at 97% of capacity. This rate, or one higher, was forecast to continue through 1988 as the industry benefited from limited capacity and strong demand levels in the world marketplace.

Newsprint's companion, uncoated groundwood specialty grades, have increased their output every year since 1979, with old newsprint machines being converted to produce the more profitable groundwood grades. Production jumped by 19.7% from 1983 to 1984, by 14.6% from 1984 to 1985, by 15% from 1985 to 1986, and by 11.3% from 1986 to 1987. Groundwood machines produced more than 1.3 million tons of paper in 1987, as compared with just over 600,000 tons at the beginning of the decade.

The book and writing papers segment has also regained ground lost in the recession years of the early 1980s. Production increased 6.4% in 1985 over 1984, as compared with 6.8% in 1984 over 1983. A 7.9% increase in 1986 brought levels up to almost 1.2 million tons, and another 10% boost in 1987 moved this sector up to nearly 1.3 million tons.

Tissue production jumped 12% from 1984 to 1985, but the growth rate slowed to 4.0% in 1986, bringing output up to 465,000 tons, about the same as in 1987.

Kraft papers and board a mixed bag. Kraft paper production dropped steadily in the 1980s, rising by about 4% in 1983 but dropping again by 8.9% in 1984. However, a rally began again in 1985, as production increased by just over 13%. This was followed by another jump of 10.9% in 1986 to 540,000 tons and further growth of 4.8% in 1987 to 567,000 tons.

While kraft paper was hurting badly in the early 1980s, containerboard was on a roller coaster ride. Output rose in

CANADIAN PAPER AND PAPERBOARD PRODUCTION BY MAJOR GRADES, 1979-87

(000 metric tons)

PAPER

Year	Newsprint	Groundwood printing, specialties	Book & writing	Kraft papers	Tissue, special papers	Total paper	Operating rates: News-print	Operating rates: Other papers
1987	9,672	1,359	1,297	567	456	13,351	96%	93%
% change year ago	4.1	11.3	10.0	4.8	–0.6	5.2		
1986	9,288	1,221	1,179	541	459	12,688	94	94
1985	8,988	1,050	1,093	487	447	12,065	92	97
1984	9,013	916	1,027	430	399	11,785	92	94
1983	8,486	765	961	472	385	11,069	85	88
1982	8,117	649	831	453	375	10,425	82	82
1981	8,946	645	787	490	388	11,256	94	83
1980	8,625	614	895	533	377	11,045	94	88
1979	8,709	611	914	588	381	11,203	97	99

PAPERBOARD

Year	Container-board	Of which: Linerboard	Of which: Corrug. medium	Boxboard	Total paperboard	Total paper & paperboard	Operating rate, paperboard
1987	1,953	1,255	698	742	2,695	16,046	99%
% change year ago	5.7	4.7	7.7	2.2	4.7	5.1	
1986	1,847	1,199	648	726	2,573	15,261	96
1985	1,677	1,126	551	697	2,374	14,438	89
1984	1,695	1,087	608	745	2,440	14,226	92
1983	1,573	1,022	551	711	2,284	13,353	88
1982	1,365	887	478	618	1,983	12,408	74
1981	1,646	1,088	558	701	2,347	13,603	89
1980	1,671	1,175	496	673	2,344	13,389	95
1979	1,541	1,075	466	742	2,283	13,486	91

Source: Canadian Pulp & Paper Assn.

1980, fell modestly the next year, and tumbled by 13.3% in 1982, only to bounce back by the same amount in 1983. In 1984, a record 1.69 million tons was produced, up 7.8% from the previous year. As with other grades, 1985 figures could not stand up to those 1984 records, and levels dropped by just over 1% to finish the year at 1.68 million tons. A strong turnaround in 1986, with an increase of 9.8%, boosted production to almost 1.85 million tons. This was followed in 1987 by a 5.4% jump to 1.9 million tons.

Boxboard production zig-zagged during the entire decade, dropping in 1980, rising in 1981, falling the next year, and bouncing back the following year. This rising trend continued into 1984 before reverting the pattern and registering a 6.4% drop in 1985. The seesaw continued as 1986 figures rose 6.4% to finish the year at 726,000 tons. And the upward trend continued in 1987, when production rose again by a modest 2.2% to 742,000 tons.

Pulp posts steady gains. The Canadian woodpulp industry, which shares top billing with the newsprint sector, has seen production rise slowly but surely since the almost 12% slump from 1981 to 1982. Increased worldwide demand and currency valuations favorable to Canadian producers have contributed to the strength in market pulp exports, while healthy demand for paper and board products

CANADIAN PAPER AND PAPERBOARD EXPORTS BY MAJOR GRADES, 1979-87

(000 metric tons)

Year	Newsprint	Groundwood printing	Book, writing	Kraft papers	Tissue	Containerboard	Of which: Linerboard	Of which: Corrug. medium	Boxboard	Total paper/paperboard
1987	8,573	1,137	432	320	64	544	325	219	80	11,149
% change year ago	4.8	10.2	38.9	6.7	4.9	2.8	–1.2	–9.5	–21.2	6.4
1986	8,180	1,032	311	300	61	529	329	200	66	10,480
1985	7,964	900	278	237	56	422	280	143	61	9,920
1984	7,949	767	252	192	38	475	267	207	76	9,748
1983	7,469	636	239	234	24	461	268	193	57	9,120
1982	7,139	546	174	218	24	356	220	136	28	8,485
1981	7,871	524	127	207	26	400	256	114	40	9,195
1980	7,642	517	201	241	24	458	346	112	38	2,121
1979	7,783	486	204	240	33	350	254	96	64	9,160

Source: Canadian Pulp & Paper Assn.

CANADIAN WOODPULP EXPORTS BY MAJOR GRADES, 1979-87

(000 metric tons)

Year	Bl. sulfite	Unbl. sulfite	Bl. softwood sulfate	Bl. hardwood sulfate	Semibl. sulfate	Unbl. sulfate	Total chemical paper-grade	Mechanical	Diss. & special alpha	Total woodpulp
1987	375	38	5,789	761	393	111	7,466	376	221	8,063
% change year ago	4.2	–15.5	7.0	6.6	–9.2	–9.0	5.4	–1.3	0.8	9.5
1986	360	45	5,409	714	433	122	7,083	381	220	7,683
1985	280	47	4,919	692	411	152	6,502	303	204	7,008
1984	281	52	4,565	710	349	155	6,110	382	207	6,699
1983	255	52	4,941	541	377	186	6,352	245	198	6,795
1982	253	62	4,200	366	320	171	5,372	232	219	5,823
1981	360	93	4,613	399	407	212	6,084	257	258	6,591
1980	355	102	5,049	381	496	221	6,610	294	291	7,195
1979	369	81	4,791	363	457	256	6,331	99	351	6,782

Source: Canadian Pulp & Paper Assn.

has kept up production destined for internal use.

Market pulp production was up 9% overall in 1986, with total output for the year at 8.5 million tons; it was followed in 1987 by a more modest 5.8% jump to just over 9.0 million tons. The largest increase was posted in 1987 by bleached sulfate pulp, which rose almost 8%. Bleached softwood kraft pulp, representing the bulk of market pulp shipments, finished the year with a total of 6.3 million tons, up 7.8% from 1986 levels. The other big winner was bleached sulfite pulp, which rose 6% to 437,000 tons.

Total woodpulp production in 1987 was up by 6% to 22.8 million tons. Semichemical was the leader with a 10% increase. The largest segments, bleached softwood kraft and mechanical pulp, posted increases of 8.9% and 6.2%, respectively. Operating rates for chemical paper grade pulp mills, half of the total industry, jumped from 87% in 1984 and 1985 to 92% in 1986, and they were running at 104% in 1987.

EXPORTS REACH RECORD LEVELS

Canada is the world's largest exporter of pulp and paper, accounting for almost one-third of all international trade in those products. As would be expected, newsprint and market pulp are the largest export groups, mirroring their leading position in overall production. In 1987, total exports reached a record level of 1.92 million tons, 6% higher than in 1986, as Canadian products benefited on the world market from the weakness in the Canadian and U.S. dollars.

Export tonnage of most grades of paper and paperboard posted good gains during 1987, although not as strong as the double-digit increases of the previous year. In fact, some grades declined, including a 21.2% drop in boxboard and a 1.2% dip in linerboard.

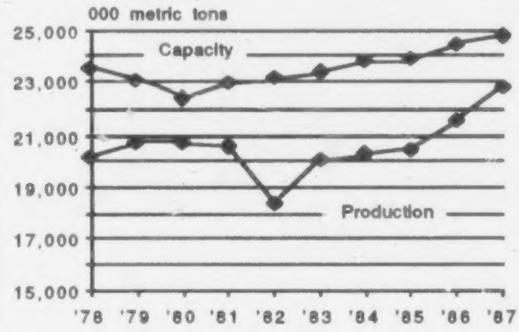
The biggest increase was in book and writing papers, which soared nearly 40%, although tonnage was up just 121,000 tons to 432,000 tons. Multiwall and groundwood printing and specialty papers also showed significant gains, rising 10.8% and 10.2%, respectively.

Groundwood papers, in general, have been strong performers since the beginning of the decade, as Canadian companies increased their capacity to respond to market conditions.

Containerboard exports were up just 2.8% in 1987, with corrugating medium up 9.5% but linerboard down 1.2%. Kraft papers showed a gain of 6.7%.

Woodpulp exports rose 4.9% in 1987, ending the year at 8.06 million tons. The volume leader in the group continued to be bleached softwood kraft pulp, which posted a 7.2% increase to 5.8 million tons. Other gains were not as significant as in 1986, when mechanical pulp exports

TOTAL PULP PRODUCTION VS CAPACITY



Source: Statistics Canada

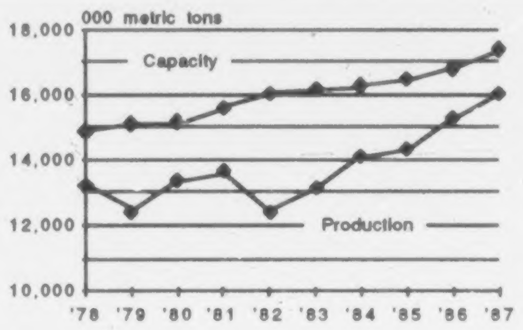
CANADIAN NEWSPRINT EXPORTS BY DESTINATION, 1979-87

(000 metric tons)

Year	United States	United Kingdom	Other western Europe	Latin America	Asia	Other countries	Total
1987	7,086	322	217	422	388	138	8,573
% change year ago	5.2	9.9	24.0	1.4	9.6	–33.6	4.8
1986	6,734	293	175	416	354	208	8,179
1985	6,674	274	74	327	455	159	7,964
1984	6,586	376	143	357	355	132	7,949
1983	6,033	502	163	428	246	97	7,469
1982	5,614	541	170	471	240	103	7,139
1981	6,062	541	189	625	356	98	7,871
1980	6,117	442	181	518	267	116	7,641
1979	6,347	398	187	445	247	159	7,783

Source: Canadian Pulp & Paper Assn.

TOTAL PAPER AND PAPERBOARD PRODUCTION VS CAPACITY



Source: Statistics Canada

soared 21.8% above 1985 and overall pulp exports were up by 9.5%.

Western Europe regains prominence. The U.S. continues to be the most significant market for the important Canadian exports of newsprint and market pulp. However, exports to EEC countries in western Europe, after declining during the 1982-85 period, showed healthy increases in 1986 and maintained these higher levels in 1987 due to the relationship of the Canadian dollar vis-à-vis the European currencies.

In 1986, newsprint exports to this region rose 136.5%, to 175,000 tons, while woodpulp exports increased by a less astounding 17.7% to finish at 1.7 million tons. In 1987, newsprint exports were up a more modest 23.4% to 216,000 tons, while woodpulp exports were relatively flat, moving up just under 1% to 1.8 million tons.

Latin America is the largest market for Canadian newsprint after the U.S. Exports during 1987 reached 422,000 tons, an increase of just 1.4% (although this

CANADIAN WOODPULP PRODUCTION BY MAJOR GRADES, 1979-87

(000 metric tons)

Year	Bl. sulfite	Unbl. sulfite	Total sulfite	Bl. softwood sulfate	Bl. hard-wood sulfate	Semibl. sulfate	Total bl. & semibl. sulfate	Total white pulps	Unbl. sulfate	Total chem. paper-grade
1987	454	1,296	1,750	6,887	1,324	1,169	9,379	11,129	1,474	12,603
% change year ago	6.1	3.8	4.4	8.9	1.9	–1.5	6.5	6.1	4.5	5.9
1986	428	1,248	1,676	6,324	1,299	1,187	8,810	10,486	1,410	11,896
1985	329	1,269	1,598	5,873	1,174	1,170	8,217	9,815	1,383	11,198
1984	366	1,405	1,771	5,568	1,214	1,065	7,847	9,618	1,468	11,087
1983	305	1,353	1,658	5,705	1,035	1,022	7,762	9,420	1,486	10,906
1982	281	1,444	1,725	5,098	817	921	6,836	8,561	1,142	9,703
1981	430	1,819	2,249	5,443	812	1,057	7,312	9,561	1,497	11,058
1980	405	1,763	2,168	5,922	832	1,182	7,936	10,104	1,688	11,792
1979	407	1,833	2,240	5,559	818	1,104	7,481	9,721	1,690	11,411

Year	Semichem.	Mechanical	Screenings	Total paper-grade	Diss. & special alpha	Total woodpulp	Operating rate
1987	353	9,628	17	22,602	241	22,843	92%
% change year ago	10.0	6.2	–10.5	6.6	8.1	6.1	
1986	321	9,067	19	21,304	223	21,527	87
1985	258	8,542	17	20,015	222	20,237	87
1984	331	8,513	17	19,948	221	20,169	87
1983	305	7,778	15	19,004	217	19,221	86
1982	252	6,815	17	15,787	220	17,007	76
1981	322	7,631	19	19,030	274	19,304	86
1980	333	7,706	26	19,657	311	19,970	95
1979	323	7,388	26	19,418	368	19,516	90

Source: Canadian Pulp & Paper Assn.

followed a rise of 27.2% in 1986 over 1985 levels). However, this new export level is misleading, as there had been a steady decline in Latin American exports since 1981, when shipments totaled 625,000 tons. The lowest level during this period, 327,000 tons, was posted in 1985.

Japan has become an increasingly important customer for Canadian woodpulp, with exports to that country rising 15.5% to 911,000 tons in 1986 and 12.6% to 1.03 million tons in 1987. Exports to Japan have increased more than 43.7% overall since 1981. Exports to "other countries," including the rest of Asia and Africa, are the next most important market, with 1.05 million tons shipped to these regions during 1987. These exports have more than doubled since 1981.

Imports not a factor. Because the major focus in the Canadian pulp and paper industry is on production for export as well as domestic use, imports have never played a significant role in the total picture. Compared with the over 18.16 million tons of pulp, paper, and paperboard shipped out of Canada in 1986, imports during that year totalled slightly under two million tons. Woodpulp imports for 1986, according to preliminary estimates, were an even less significant part of that total, reaching 219,000 tons at year-end.

CANADIAN WOODPULP SHIPMENTS[1] BY MAJOR GRADES, 1979-87

(000 metric tons)

Year	Bl. sulfite	Unbl. sulfite	Bl. softwood sulfate	Bl. hardwood sulfate	Semibl. sulfate	Unbl. sulfate	Total chem. paper-grade	Mechan-ical	Diss. & special alpha	Total wood-pulp
1987	437	48	6,317	911	476	119	8,309	488	243	9,040
% change year ago	6.1	–5.9	7.8	7.7	–10.0	–10.5	6.1	4.0	1.7	5.8
1986	412	51	5,860	846	529	133	7,832	469	239	8,540
1985	329	52	5,357	819	506	158	7,221	384	216	7,820
1984	330	60	5,021	877	436	161	6,884	464	221	7,569
1983	296	61	5,332	745	418	191	7,043	317	209	7,569
1982	275	76	4,515	537	356	181	5,940	273	227	6,440
1981	387	105	4,979	602	485	226	6,784	284	271	7,339
1980	392	122	5,381	592	579	232	7,298	322	310	7,930
1979	406	111	5,096	558	531	264	6,966	109	371	7,446

[1] Excluding pulp sent to integrated and affiliated mills inside Canada.

Source: Canadian Pulp & Paper Assn.

CANADIAN WOODPULP EXPORTS BY DESTINATION, 1979-87

(000 metric tons)

Year	United States	United Kingdom	Other western Europe	Latin America	Japan	Other countries	Total
1987	3,582	395	1,804	204	1,026	1,052	8,063
% change year ago	1.5	–8.8	3.4	7.9	12.6	20.2	4.9
1986	3,530	433	1,745	189	911	875	7,684
1985	3,408	321	1,483	155	789	852	7,008
1984	3,426	385	1,391	146	708	643	6,700
1983	3,289	272	1,594	101	744	795	6,795
1982	2,857	269	1,431	65	682	520	5,824
1981	3,250	326	1,667	96	692	568	6,599
1980	3,433	377	1,794	142	885	564	7,195
1979	3,577	408	1,606	86	689	416	6,782

Source: Canadian Pulp & Paper Assn.

PRICES

Canada's pulp and paper industry exists to serve export markets far more than to serve the domestic market, and the industry's export products are generally priced in U.S. dollars. In recent years, this has been a considerable blessing for the industry, since the Canadian dollar fell from approximate parity with the U.S. dollar as recently as 1977 to below 75 cents by 1985. That decline meant unexpected profits for export-oriented companies—as much as 50% to 100% of many companies' income. In a decade when profits of any kind have been scarce, Canada's weak currency has meant the difference between life and death for parts of its pulp and paper industry.

This weakness has also given Canadian producers a competitive cushion that their U.S. counterparts have not enjoyed when market weakness prevented price increases. For example, discounting was prevalent in the U.S. newsprint market in 1984, and real U.S. dollar prices were below their level of three years earlier. Nevertheless, eastern Canadian mills made money on sales of newsprint to the U.S. because of the dollar differential. And it is difficult to see how British Columbia's mills could have remained in business through the down period of the early 1980s without the weak Canadian dollar.

EXPORT GRADES BOUNCE BACK

Pulp prices performed dismally for Canadian producers during the first half of the 1980s, but boom conditions in 1986 and 1987 have helped ease the sting. Bleached kraft export prices rose an average of 8.4% annually from 1976 to 1980, but during the 1981-85 period, prices declined 0.1%/year, or 10.2% for the five-year period. Bleached sulfite and unbleached kraft were hit just as hard. After dropping 15% in 1985, however, bleached sulfate pulp export prices jumped 13% in 1986 and an estimated 17% in 1987.

Thanks to their weaker currency, Canadian producers were not hit as hard as their U.S. counterparts during the down years. Between 1977 and 1986, the price of northern bleached softwood kraft (NBSK) in U.S. dollars rose about 25% in northern Europe and 22% in the U.S. The increase in Canadian dollars was 66% in Europe and 62% in the U.S. As the dollar began to weaken in 1985, the Canadian dollar dropped as well, maintaining the Canadian cushion. The Canadian dollar bottomed out against the U.S. dollar in the last quarter of 1986, at US72¢. During 1987, the differential narrowed to US76¢ by the end of the year, and it topped the US80¢ mark in the first quarter of 1988.

In the second quarter of 1980, the price of Canadian bleached softwood kraft pulp exported to Europe hit an all-time high of US$545/metric ton, c.i.f. northern Europe. In the first quarter of 1982, producers attempted to raise the benchmark price further by $35. Not only did they fail, but the soon-evident worldwide recession drove pricing so far backward that, by August 1982, list quotes were down to the late-1979 level of $465—only $30 above the previous peak achieved in early 1975. By the first quarter of 1983, they had fallen still further to just $410, with spot-market quotes below that readily available.

A shutdown in British Columbia caused by a labor dispute firmed up markets in early 1984, sparking a price recovery to $540/ton for NBSK in Europe. But overcapacity and the very strong U.S. dollar combined to knock market pulp back down again. By the end of 1984, NBSK was selling in northern Europe for around $470 to $480, and prices plummeted to the $390 level in early 1985.

After the U.S. dollar began to weaken and markets to strengthen in late 1985, producers were able to push through four consecutive quarterly price hikes in 1986, bringing NBSK back to $520/ton. The declining dollar benefited U.S. and Canadian producers alike, reversing the cost advantage of Scandinavian competitors and making price increases easy for overseas customers to absorb.

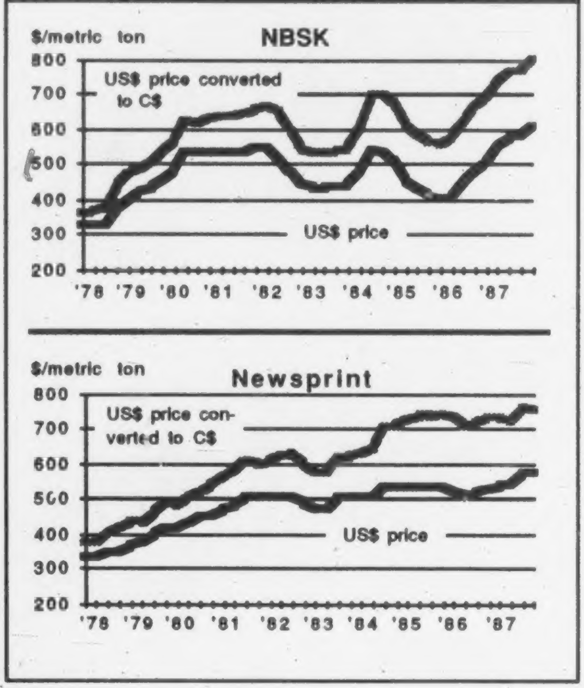
Producers followed their 1986 successes with four more quarterly increases in 1987, raising NBSK in Europe to $635 by the final quarter, a new record high. The increase was held to $610 in the U.S., however, widening the price differential that opened because of U.S. customers' lack of protection from the falling dollar. Prospects appeared good for more increases in 1988, as pulp producers enjoyed a sellers' market characterized by extremely high operating rates, low producer inventories, little new capacity, and no letup in demand.

Newsprint. Newsprint prices fared much better than pulp during the early 1980s. Export prices climbed an average of 6.7%/year between 1981 and 1985, with only one year of decline in 1982. That performance was still down compared to the late 1970s, when prices climbed an average of 11.9%/year.

Canadian mills selling newsprint in the U.S. for US$500/metric ton tried raising their prices $25/ton in March, April, and June of 1982. Each time, a sizeable group of small and large producers undercut the leaders' price hikes, preferring to maintain operating rates rather than support the increase.

Mills were still trying to raise prices in the fourth quarter of 1982 when widespread discounting forced them to reverse direction and actually cut their lists to $468.50. It was not until the third quarter of 1983 that they got the list back up to the previous level east of the Rockies (starting in July 1982, western producers offered contract customers 5% discounts from list price levels). And prices did not finally get above $500 until July 1984 when eastern mills went up to $535, although discounting from this level continued through the year and into 1985.

PRICES IN THE U.S. MARKET
U.S. vs CANADIAN DOLLARS



Producers failed to raise prices seven times in 1985, as soft demand continued and as imports of cheap offshore paper increased. Gradually improving demand in 1986 finally firmed up markets enough to allow a price hike in October, bringing the list price to $570. However, most tonnage was still sold in the $530 to $550 range, and the increase was not implemented fully until early 1987. Markets remained strong in 1987, and producers were able to increase prices on July 1 and again on January 1, 1988. The July increase brought the list price up to $610 in the eastern U.S., and the January hike raised it to $650. Transaction prices continued significantly below list, in the range of $570 to $610 at the beginning of 1988.

During the 1980s, Canadian newsprint exporters were well served by the weak Canadian dollar, which shielded them from the worst of the price weakness at the beginning of the decade and which made the subsequent price recovery all the more profitable. While newsprint prices rose about 59% in U.S.-dollar terms between 1977 and 1986 in the U.S. market, the increase was 111% in Canadian dollars.

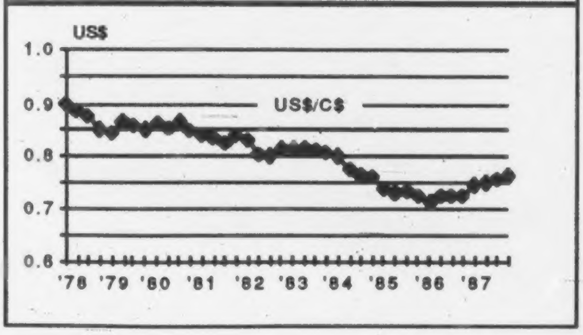
DOMESTIC PRICING

Historically, Canadian prices have not risen as rapidly for products intended for domestic use as they have for major export commodities. That was not true of the 1976-85 period, however. Among the export grades, only newsprint rose faster than the domestic prices for printing and writing papers and containerboard. Domestic containerboard prices rose an average of 7.9%/year during the 1976-85 period vs 9.3% for exported newsprint and only 5.3% for bleached kraft pulp exports. Fine paper prices in the domestic market rose an average of 5.7% annually over the same period.

Domestic containerboard prices rose 1.4% in 1986, the last year for which price-index statistics are available. Fine paper prices in the domestic market rose 3.7%.

Canadian prices generally track U.S. pricing activity, but Canadian mills enjoy a comfortable dominance of their domestic markets in the whole range of pulp, paper, and

CANADIAN DOLLAR DECLINE
vs U.S. DOLLAR



board products, and that helps them to maintain adequate pricing. For example, in 1985 the major imported pulp and paper commodity was 257,000 metric tons of printing and writing papers (about 30% of apparent domestic consumption), while no other single commodity exceeded the 48,000 tons of imported wrapping papers.

Thus, when U.S. prices for printing and writing papers were near their cyclical peak in early 1981 and when coated No. 3 printing paper (60 lb in rolls) was going for $897/short ton, Canadian buyers were paying the equivalent of US$1,070, by one estimate. Also, at that time Canadian consumers were paying an estimated US$30/short ton more for their 50-lb multiwall kraft sack paper than the $405 price in the U.S.

The price index for domestic writing and reproduction papers in Canada rose 73% between 1976 and 1985. Over the same period, the uncoated free-sheet price index in the U.S. rose 69%. The disparity was much higher in containerboard, where Canadian prices climbed 99% during the 1976-85 period compared with 58% in the U.S. for kraft linerboard. Canadian producers of those grades were better able to pass along price hikes in their domestic market than in the U.S., although with the weak Canadian dollar, they were able to get by with small U.S. price hikes.

Trade barriers are one reason for the price disparity. Domestic producers were protected in the past by relatively high tariffs in the 15% range on a range of grades. However, a staged reduction from 1980 to 1987 has reduced those barriers by more than half in most cases. In 1987, the U.S. and Canada negotiated a trade agreement to remove the remaining barriers and to open both markets to free competition.

PRICE INDEXES FOR SELECTED COMMODITIES

(1981=100)

	Fine paper—writing and reproduction (domestic)	Containerboard (domestic)	Bleached sulfite pulp (export)	Bleached sulfate pulp (export)	Unbleached sulfate pulp (export)	Newsprint (export)
1986	119.2	137.2	95.6	98.2	98.1	123.0
1985	114.9	135.3	83.7	87.3	86.9	119.7
1984	112.6	128.9	97.1	102.3	102.2	109.6
1983	106.4	119.3	79.7	80.9	80.6	98.7
1982	106.4	112.1	92.4	93.6	93.5	104.7
1981	100.0	100.0	100.0	100.0	100.0	100.0
1980*	219.0	238.5	342.1	341.0	379.0	300.2
1979*	197.7	200.2	279.4	278.9	303.0	268.0
1978*	173.6	171.7	210.2	213.1	216.0	236.4
1977*	165.0	166.7	220.8	233.1	221.0	210.4
1976*	161.6	162.5	218.8	230.6	226.9	177.6
Average annual change						
1981-86	3.6%	6.6%	0.2%	0.9%	0.9%	4.4%
1976-80	6.3	9.4	8.8	8.4	11.3	11.9

* Base year for 1976-80 data is 1971.

Source: *Statistics Canada*.

PROFITABILITY

Virtually the entire North American pulp and paper industry had an excellent year in 1987. On both sides of the border, and for many of the same reasons, producers watched their profits soar to record heights as the year progressed.

For Canadian companies, as in the U.S., a weak currency that encouraged exports provided a healthy boost for sales. Strong demand increased the volume of shipments in most grades and allowed producers to raise prices. Cost-reduction programs instituted as survival measures in recent years also contributed to dramatic earnings increases at several companies.

Tight markets and record production for market pulp and newsprint, the two main exports of the Canadian forest-products industry, translated into 1987 profits that were nearly twice the 1986 level. Earnings in 1987 increased 94.3%, and sales rose 16.8%. Producers were helped by the weakness of the Canadian dollar in relation to most European currencies, although some strengthening against the U.S. dollar was a negative factor. Nevertheless, most industry executives remained optimistic about prospects for 1988.

MacMillan Bloedel Ltd. enjoyed both record sales and earnings in 1987. Sales exceeded the $3-billion mark for the first time in the company's history. Operating earnings more than doubled to reach $465.8 million. The company reported that earnings would have been even better if British Columbia had not instituted its new stumpage system. MB also reported that it expects its pulp and paper mills to continue running at the capacity levels achieved during 1987.

Abitibi-Price Inc.'s earnings rose 17%, while sales were up 8%. Bernd K. Koken, chairman and CEO, attributed the increase to strong newsprint prices and to the fact that the company's mills operated at capacity. Koken said the unfavorable exchange rate from selling newsprint in the U.S. cut into its profits, and he noted that the average value of the U.S. dollar in Canadian terms declined 4.6% from 1986. However, he was optimistic about prospects for 1988. "Newsprint markets will be at their best, and we expect a solid turnaround in the groundwood-papers and coated-papers segments."

Domtar Inc., which recorded an 11% increase in earnings, reported that although operating profits for pulp, newsprint, and groundwood specialty papers improved significantly, earnings from the fine-papers segment declined. The company attributed this decline to reduced operations at the old Windsor, Que., mill in preparation for the startup of a new uncoated free-sheet paper machine.

Consolidated-Bathurst Inc. said its preliminary earnings before extraordinary items reached a new record of $181.5 million, a 75% improvement over 1986. Con-Bath attributed the good showing to strong results at its Bridgewater Div. in the U.K. and to higher shipments and better prices in newsprint, market pulp, and containerboard. President T.O. Stangeland described the company's 1988 outlook as "quite positive."

British Columbia Forest Products Ltd. enjoyed record sales and earnings in 1987. BCFP's earnings exceeded $100 million for the first time in its 40-year history, and the company posted its largest earnings gain since 1979.

Like BCFP, Canfor Corp.'s net income exceeded $100 million for the first time, an increase of $79 million over 1986. Canfor said that profits would have been even better without the export charge on lumber, which cost the company about $23 million. Canfor returned to profitability only in 1986, following four years of losses. Crown Forest Industries Ltd.'s earnings were almost twice as large as its previous best profit in 1979. Sales broke the $1-billion barrier for the first time.

Repap Enterprises Corp.'s earnings were almost four times larger in 1987 than in 1986. Nonintegrated Rolland Inc. was one of the few companies to see earnings fall in 1987. The company said that its Fine Papers Div. was adversely affected by rising raw-material costs, which could not be matched by corresponding increases in its selling prices.

OUTLOOK FOR 1988

Canadian forest-products companies enjoyed a 41.6% increase in profits on a 10.9% increase in sales during the first quarter of 1988. But, unlike their U.S. counterparts, Canadian producers were not optimistic about the prognosis for 1988, primarily because the appreciating Canadian dollar is making the U.S. market a less-profitable place for Canadians to do business. Ongoing labor negotiations at pulp, paper, and sawmills in British Columbia also have some companies feeling uneasy, and the newsprint sector has shown signs of softness.

During March and April of 1988, the Canadian dollar averaged about US81¢, compared with the 76¢ it was worth in fourth-quarter 1987. For all of 1987, the Canadian dollar's average worth was 75.5¢ to the U.S. dollar, a 4.9% increase over 1986 levels. Canadian companies are also looking offshore to lessen their dependence on the U.S. Major Canadian companies expanding offshore include Noranda Forest Inc. in Australia, Abitibi-Price in Venezuela, and Consolidated-Bathurst in China.

Abitibi-Price reported that its earnings were more than double the 1987 quarter. Koken said he was optimistic that Abitibi would achieve solid earnings growth in 1988, but he admitted that he remained concerned about the detrimental effect of a strengthening Canadian dollar.

Adam Zimmerman, chairman of Noranda Forest, said he expects the current strong market conditions to continue throughout 1988. Noranda's profits were 49% above the 1987 quarter. MacMillan Bloedel, which is 50% owned by Noranda Forest, enjoyed a 52% improvement in earnings. First-quarter price increases for newsprint, pulp, linerboard, and premium lumber grades helped offset higher log costs, a higher Canadian dollar, and lower-than-planned newsprint production due to maintenance and startup projects.

Domtar reported that earnings fell about 16%, primarily due to lower U.S. prices for gypsum wallboard. Consolidated-Bathurst saw its earnings increase 61% during the quarter on a 9.3% increase in sales. Improved prices in most product lines offset lower shipments of newsprint and the effects of the strong Canadian dollar, the company said.

British Columbia Forest Products enjoyed the highest quarterly earnings in its history. CEO Ian Donald characterized the short-term outlook as "bullish" but warned that an "aggressive reinvestment program is necessary to keep the company competitive." BCFP and its affiliates plan to spend a record C$1 billion on projects to "stay internationally competitive in this global business." Donald said the rising value of the Canadian dollar "jeopardizes the company's ability to compete in offshore markets," and he added that the effect of each 1¢ increase in its value results in a $5-million reduction in earnings for BCFP."

Canfor is also vulnerable to the strengthening Canadian dollar. Its profits rose 40% in the quarter. Like many other companies in British Columbia, Canfor is unhappy with the new stumpage policy introduced in the province in October 1987.

Repap reported that earnings rose 42.5% from the 1987 quarter. "Had it not been for the sharply accelerating strength of the Canadian dollar, earnings would have been higher by $2.5 million," said George Petty, chairman and CEO.

CANADIAN PULP AND PAPER COMPANY SALES AND EARNINGS FOR 1987

(C$000)

Companies	Sales	% change 1987/86	Earnings	% change 1987/86
Abitibi-Price	C$2,988,000	8.1%	C$125,700	17.1%
B.C. Forest Products	1,400,000	27.3	140,200	248.8
Canfor	1,244,900	18.9	102,700	333.3
Cascades	527,732	19.9	34,148	1.1
Consolidated-Bathurst	2,261,000	12.0	214,400	334.0
Crown Forest Industries	1,000,000	15.7	100,700	287.3
Domtar	2,568,000	10.4	161,000	11.0
Donohue	510,100	7.3	44,200	80.4
Great Lakes Forest Products	752,221	18.0	96,185	220.1
MacMillan Bloedel	3,134,500	24.8	230,600	57.4
Noranda Forest	4,246,500	19.2	203,200	97.9
Repap Enterprises	927,000	45.9	62,500	380.8
Rolland	387,700	12.5	4,910	–33.3
Scott Paper	288,396	10.1	14,514	12.3
Weldwood of Canada	741,035	12.5	47,592	58.4
West Fraser Timber	411,700	[illegible].3	47,200	17.4
Total	23,388,784	[illegible].8	1,679,749	94.3

1. Income after taxes, from continuing operations, excluding most significant nonrecurring items in both years. Dollar amounts are rounded to nearest hundred.

CAPACITY EXPANSION

Taking advantage of their higher earnings, Canadian pulp and paper companies plan to boost paper and board capacity by 2.4%/year through 1989, well above the ten-year average rate of 1.3%.

According to the 1987 Canadian Pulp & Paper Assn. capacity survey, Canadian producers will continue to concentrate their expansion efforts in the higher-value grades of paper and in mechanical market pulp. In comparison with these grades, capacity for newsprint and bleached softwood kraft market pulp—Canada's top export commodities—was expected to grow sluggishly, although newsprint began to show signs of heating up in mid-1987 after the CPPA survey was finished, as did market pulp later in the year.

Plans call for a 42.7% increase in printing and writing papers by 1989, raising capacity 1.07 million metric tons to 3.58 million tpy. After factoring in two projects approved after completion of the CPPA survey, newsprint capacity will grow by 721,000 tons by 1989, or 7.3%, boosting total capacity to 10.61 million tpy.

In the market-pulp sector, producers will add 651,000 tons of mechanical pulp by 1989 (including two projects approved after the CPPA survey), raising total capacity by 110.5% to 1.24 million tpy. NBSK capacity will climb 9.1% over the same period, raising total capacity 351,000 tons to 5.89 million tpy.

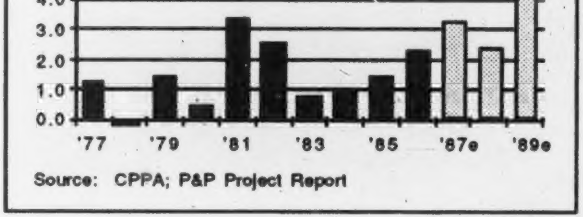
Good news for profits? According to analysts, the mix of relatively weak growth in commodities and strong growth elsewhere should be a good one for the industry over the next few years. Continued restraint in newsprint and NBSK capacity growth helped push operating rates to 98% for newsprint and to over 100% for market pulp in 1987, with similar figures forecasted for 1988. The mid-1987 surge in expansion announcements, continuing into 1988, signals an end to this restraint in the newsprint sector, but it will take several years for this new capacity to make itself felt in the market.

Printing and writing markets in the U.S. regained their vigor in 1987 after a period of softness due to a large increase in capacity. Continued strong growth in the domestic market in Canada and the reduction of trade barriers in the U.S., where a substantial amount of new production is targeted, should help Canadian papermakers avoid overcapacity problems.

Twice the historical rate. Total paper and board capacity will climb 2.25 million tons, or 13.4%, between 1986 and 1989, rising to 19.1 million tpy by the end of the period, the CPPA survey reported. Growth will average 4.3%/year, compared with 1.3%/year between 1976 and 1986.

Total woodpulp capacity will rise 1.38 million tons to 25.89 million tpy, an increase of 5.6% over the three-year period. That averages out to 1.9%/year, up from 0.7% annually for the previous ten years. Market pulp capacity is expected to reach 8.49 million tpy by 1989, a 6.3% increase. The growth rate for market pulp will jump to

PAPER & PAPERBOARD CAPACITY GROWTH



Source: CPPA; P&P Project Report

2.1%/year, up from 1.0% for the 1976-86 period.

Printing/writing papers. Groundwood specialty and printing papers will register the strongest growth among the paper grades, rising 46.0% by 1989, according to CPPA. Conversions to supercalendered paper at Abitibi-Price Inc.'s Alma and Jonquière, Que., mills are the main factors in the 580,000-ton increase, along with a new supercalendered paper machine at St. Marys Paper Inc. in Sault Ste. Marie, Ont. Beyond the survey period, Consolidated-Bathurst Inc. will install a new 183,000-tpy groundwood specialties machine at Grand-Mère, Que., in 1990, replacing two older units.

Four new paper machines will fuel a 39.3% increase in book, writing, and miscellaneous papers capacity, adding 490,000 tons to capacity by 1989. Repap Enterprises Corp. Inc. started up a new lightweight coated groundwood machine at Newcastle, N.B., in 1986. Domtar Inc. is building two new uncoated free-sheet machines at Windsor, Que., with one targeted for startup in late 1987 and the other scheduled for the first half of 1989. The fourth new unit, also uncoated free-sheet, is under construction at Weyerhaeuser Canada Ltd.'s Prince Albert, Sask., facility. Startup is targeted for late 1988 or early 1989.

Another uncoated free-sheet machine, announced after the CPPA survey by Great Lakes Forest Products Ltd. for its Dryden, Ont., mill, will raise capacity an additional 175,000 tons by 1989, bringing the overall increase to 53.3%. In early 1988, Repap announced that it would install a second machine at Newcastle by late 1989 to produce 200,000 to 260,000 tpy of coated papers, both groundwood and free-sheet.

Newsprint. Only modest growth in newsprint was expected when the CPPA survey was conducted at the end of 1986, but new projects announced in mid-1987 have changed that picture. In the original CPPA scenario, machine retirements and conversions would partially offset increased capacity in the newsprint sector from two new paper machines, keeping capacity expansion down to a modest 275,000 tons, or 2.8%, for the three-year period. The first of these new machines started up in early 1987 at CIP Inc.'s Gatineau, Que., facility, while the second was scheduled to come online later in the year at Donohue Inc.'s Clermont, Que., mill.

In mid-1987, however, two new newsprint machine installations were approved for startup in 1989, raising the capacity expansion figure for the 1987-89 period to 721,000 tons, up 7.3% from 1986. The new machines are a 225,000-tpy unit at CIP's Gold River, B.C., mill and a 216,000-tpy machine for Finlay Forest Industries, Mackenzie, B.C., mill. In early 1988, Atlantic Packaging Products Ltd. announced that it also was building a newsprint machine at Whitby, Ont., for startup in 1989. That unit will produce 150,000 tpy. Beyond the 1989 horizon, two more newsprint machine installations have been approved: a 220,000-tpy newsprint mill to be built by Alberta Newsprint Co. at Whitecourt, Alta., for startup in 1990 and a 192,500-tpy machine for Howe Sound Pulp & Paper Ltd. for startup in 1991 at Port Mellon, B.C.

Market pulp. The strongest growth in the market-pulp arena will come in mechanical pulp, including thermomechanical pulp (TMP) and chemi-thermomechanical pulp (CTMP). These grades, which represent only 7.4% of Canadian market pulp capacity, are expected to grow 66.4% by 1989, adding 391,000 tons to capacity.

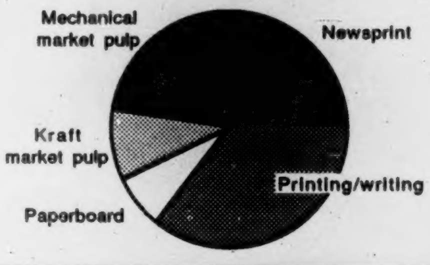
Tembec Inc. started up a new bleached market CTMP mill at Temiscaming, Que., in 1986, helping to offset the loss of capacity from the integration of groundwood market pulp by Repap Enterprises at Nelson-Miramichi, N.B. Cascades Inc. started up three new fluff CTMP lines at Port Cartier, Que., in 1987, and it was expected to bring a fourth online in early 1988. A new CTMP mill at Millar Western Industries' Whitecourt, Alta., facility was also scheduled for startup in 1988.

A third bleached CTMP facility, not included in the CPPA report, was scheduled for completion at Taylor, B.C., in 1988. The Fibreco Export Inc. mill will add 180,000 tpy to capacity. Also excluded from the survey was a recently approved expansion of 80,000 tons at Quesnel River Pulp Co. The two projects raise the total increase to 651,000 tons, up 110.5% from 1986.

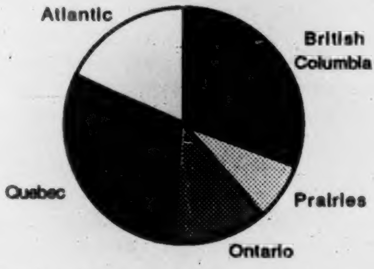
Kraft market pulp capacity was expected to grow only 93,000 tons by 1989 for an increase of 1.4%. Bleached softwood capacity will climb 141,000 tons, or 2.6%, while hardwood will decline 60,000 tons, down 7.4%. Some

CAPACITY EXPANSION PLANS, 1987-89

Breakdown by Grade
(Market pulp, paper, and paperboard)



Breakdown by Region
(Paper and paperboard)



Source: CPPA; P&P Project Report

218,000 tons of new bleached softwood capacity will be added in British Columbia, most of it at four mills: Crown Forest Industries Ltd., Elk Falls; Northwood Pulp & Timber Ltd., Prince George; Repap, Skeena; and Western Pulp Limited Partnership, Squamish.

These expansions in British Columbia, together with 54,000 tons to be added in Quebec, will be offset by decreases of 76,000 tons in Saskatchewan and 51,000 tons in the Maritimes, according to CPPA. The report did not include Champion International Corp.'s 210,000-tpy expansion plans at Hinton, Alta., which raises the total increase for kraft market pulp to 303,000 tons, up 4.4% from 1986.

In early 1988, Daishowa Paper Manufacturing Co. announced final plans to construct a 340,000-tpy bleached kraft market pulp mill at Peace River, Alta. The C$500-million project was targeted for 1990. Also approved in early 1988 was a plan by Oji Paper Co. of Japan and Canfor to expand market pulp capacity 125,000 tpy at Port Mellon, B.C.

Total pulp. Stone groundwood capacity will continue to decrease over the three-year period as newsprint mills, particularly in Quebec, convert to more TMP and CTMP. Stone groundwood capacity is expected to drop 292,000 tons by 1989, down 5.1%. TMP capacity will climb 32.7% over the same period, rising 1.35 million tons.

CANADIAN INDUSTRY CAPACITY

(000 metric tons)

MARKET PULP

Year	Sulfite paper grades	Sulfate paper grades	Of which				Total chem. paper grades	Diss. & special alpha	Mechanical	Total market pulp cap.	% increase from previous year
			Bl. softwood	Semibl. softwood	Bl. hardwood	Unbl.					
1989e	328	6,928	5,537	508	749	134	7,256	253	980	8,489	1.8%
1988e	329	7,001	5,527	499	840	135	7,330	253	752	8,335	2.6
1987e	325	6,940	5,442	524	839	135	7,265	253	602	8,120	1.7
1986	316	6,835	5,396	501	809	129	7,151	245	589	7,985	6.4
1985	305	6,624	5,233	420	794	177	6,929	266	574	7,769	1.3
1984	279	6,606	5,134	405	869	198	6,885	264	521	7,670	0.1
1983	322	6,571	5,130	453	780	208	6,893	267	500	7,660	0.6
1982	369	6,471	5,128	438	669	236	6,840	305	472	7,617	2.5
1981	397	6,413	5,056	433	634	290	6,810	303	317	7,430	2.7
1980	360	6,330	4,905	550	605	270	6,690	307	240	7,237	1.8

PAPER AND BOARD

Year	Newsprint[1]	Groundwood printing	Book, writing, misc.	Kraft papers	Tissue, sanitary, spec.[2]	Containerboard	Boxboard	Total (excl. bldg., other)	Bldg., other[3]	Total paper/board cap.	% increase from previous year
1989e	10,160	1,842	1,737	573	510	1,998	793	17,613	671	18,284	2.9%
1988e	10,160	1,608	1,520	577	510	1,948	778	17,101	670	17,771	2.4
1987e	10,025	1,450	1,413	584	510	1,944	767	16,693	663	17,356	3.3
1986	9,885	1,262	1,247	579	509	1,901	775	16,158	646	16,804	2.3
1985	9,820	1,040	1,213	541	502	1,869	798	15,783	649	16,432	0.9
1984	9,820	925	1,126	531	503	1,849	798	15,552	740	16,292	0.9
1983	9,970	800	1,026	554	486	1,794	767	15,397	751	16,148	0.7
1982	9,935	750	1,008	527	492	1,799	758	15,269	767	16,036	2.9
1981	9,490	660	1,019	566	467	1,884	792	14,878	711	15,589	2.9
1980	9,130	660	982	562	437	1,818	807	14,396	750	15,146	0.3

e = Estimate.

1. Figures have not been adjusted for changes in grammage of newsprint, and they are not directly comparable year to year.
2. Includes glassine and greaseproof papers.
3. Includes wet machine board.

Source: Canadian Pulp and Paper Assn.

Sulfite pulp will also continue its long-term decline. After falling 3.7%/year between 1976 and 1986, the rate of decline will slow to 2.5%/year through 1989, reducing capacity by 145,000 tons, or 7.2%. Dissolving and special alpha capacity will increase marginally over the period, CPPA said, after declining 5.0%/year in the 1976-86 period. Bleached hardwood kraft capacity will climb 242,000 tons by 1989, a gain of 18.9%. Domtar's Windsor expansion will add 180,000 tons, while Weyerhaeuser's Prince Albert conversion to white paper will add about 50,000 tons.

NEW MILLS AND PAPER MACHINES ANNOUNCED FOR CANADA

Company	Location	Project	Grade	Capacity (metric tpy)
Started up in 1985				
James Maclaren	Masson, Que.	new machine	newsprint	196,000
Started up in 1986				
Domtar	Trenton, Ont.	new machine	corrugating medium	99,000
Repap Enterprises	Newcastle, N.B.	new mill	coated groundwood	200,000
Tembec	Temiscaming, Que.	new mill	bleached CTMP	100,000
Started up in 1987				
CIP	Gatineau, Que.	new machine	newsprint	175,000
Domtar	Windsor, Que.	new machine	uncoated free-sheet	175,000*
Donohue	Clermont, Que.	new machine	newsprint	180,000
For startup in 1988				
Consolidated-Bathurst	Bathurst, N.B.	new machine	corrugating medium	150,000*
Fibreco Export	Taylor, B.C.	new mill	bleached CTMP	180,000
Millar Western	Whitecourt, Alta.	new mill	bleached CTMP	210,000
St. Marys Paper	Sault Ste. Marie, Ont.	new machine	SC groundwood	118,000*
For startup in 1989				
CIP	Gold River, B.C.	new mill	newsprint	230,000
Domtar	Windsor, Que.	new machine	uncoated free-sheet	175,000*
Finlay Forest Ind.	Mackenzie, B.C.	new machine	newsprint	216,000
Great Lakes Forest	Dryden, Ont.	new machine	uncoated free-sheet	175,000
Weyerhaeuser Canada	Prince Albert, Sask.	new machine	uncoated free-sheet	220,000
For startup in 1990				
Alberta Newsprint	Whitecourt, Alta.	new mill	newsprint	220,000
Consolidated-Bathurst	Grand-Mère, Que.	new machine	groundwood specialties	183,000*
Daishowa Paper	Peace River, Alta.	new mill	bleached kraft pulp	340,000
Great Lakes Forest	Thunder Bay, Ont.	new machine	newsprint	240,000*
Howe Sound	Port Mellon, B.C.	new mill	newsprint	125,000
Tembec	Temiscaming, Que.	new machine	bleached paperboard	110,000
Proposed (no startup date announced)				
Abitibi-Price	Iroquois Falls, Ont.	new machine	newsprint	n.a.
Cascades	Port Cartier, Que.	new machine	newsprint	210,000
Daelim	B.C. or Alberta	new mill	bleached kraft pulp	400,000
Dong Bang Chemical	Ocean Falls, B.C.	new mill	sulfite market pulp	82,500
Donohue	Matane, Que.	new mill	SC groundwood	210,000
Louisiana-Pacific	Chetwynd, B.C.	new mill	bleached CTMP	163,000
Makin Pulp & Paper	Britannia Beach, B.C.	new mill	publication papers	135,000
Normick Perron	Val d'Or Que.	new mill	newsprint	225,000

n.a. = Not available.
* Replaces some existing capacity.

CAPITAL SPENDING

After suffering steeper declines in 1982 and 1983 than their U.S. counterparts, Canadian pulp and papermakers have been more aggressive over the 1985-87 period in raising capital expenditures. A 1987 survey of investment intentions conducted by *Statistics Canada* showed plans to spend a record C$2.53 billion on capital improvements in 1987, up 34.0% from 1986. Construction spending was estimated at $360 million for the year, up 54.6% from 1986, while spending for machinery and equipment totaled $2.17 billion, up 31.2%.

In percentage terms, British Columbia posted the largest gains. Spending in the province was expected to climb 153% in 1987 to C$496 million. Companies planned to spend $416 million in Ontario, 25.3% more than in 1986.

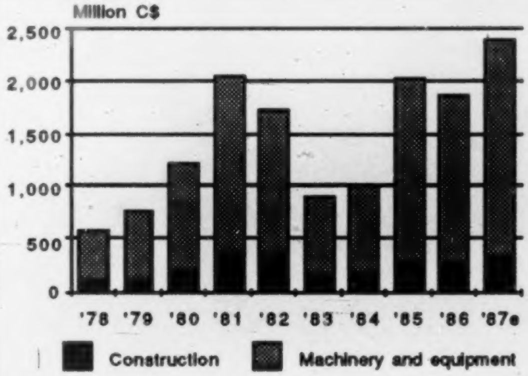
The industry in Quebec planned capital spending of $1.15 billon in 1987, up 12.8% from the previous year. Besides easily surpassing the other provinces in spending plans in 1987, Quebec was also the only one to increase spending in 1986, turning in a gain of 48.6%. In contrast, British Columbia reduced outlays to $196.1 million in 1986, down 27.8%, while Ontario cut back 42.8% to $331.6 million.

Historical pattern. The past ten years have been a roller coaster ride for capital spending in Canada. Canadian pulp and paper companies boosted capital expenditures dramatically during the late 1970s, when government assistance programs spurred outlays and the industry was gearing up for a heavy round of expansion. Total yearly outlays rose from $607 million in 1978 to a peak of $2.05 billion in 1981, an increase of 238%. However, that situation reversed itself quickly in the back-to-back recessions of the early 1980s when pulp and paper companies slashed expenditures on nonessential items. Spending in 1983 dipped to $903 million, down 48% from the previous year and down 56% from the 1981 peak.

The economic picture began to brighten during the second half of 1983, although more slowly in Canada than in the U.S., and by late 1984, capital spending plans were back on track at prerecession levels. Spending recovered modestly in 1984 to $1.01 billion, and it exploded in 1985 back above the $2-billion mark.

The big increase in 1985 spending was somewhat surprising, considering that Canadian companies had not fully recovered from the recession. Recent *Statistics Canada* figures show that Canadian pulp and paper producers spent about 10% more in 1985 on capital projects than they originally planned. Low prices and increased offshore competition put the squeeze on profit margins during this period, and the industry was also still saddled with debt from the big spending increases of 1980 and 1981. A *Pulp & Paper* survey in late 1985 found a 10% decrease in reported spending plans as many companies continued to defer spending programs. Nevertheless, capital

CONSTRUCTION VS MACHINERY COSTS IN CANADIAN CAPITAL SPENDING



Source: Statistics Canada

outlays soared to $2.04 billion for the year, a 100% increase over 1984.

The profit picture improved considerably in 1986, but capital spending slipped from the near-record 1985 pace to $1.89 billion, down 7% from the previous year. *Statistics Canada* figures show that producers spent about 13% less in 1986 than they originally planned.

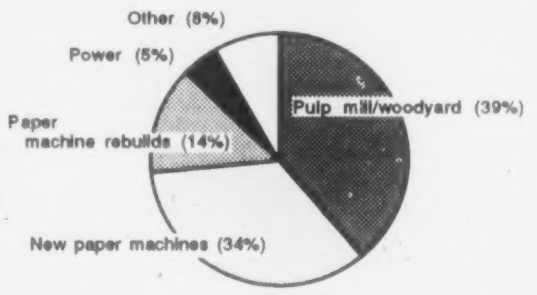
Canadian pulp and paper producers plan even larger increases in capital investment over the next few years than do their U.S. counterparts. In a *Pulp & Paper Project Report* survey conducted in late 1987, companies reported total planned outlays of C$6.7 billion for the 1987-89 period, an increase of 48% over the previous year. As in the U.S., capital spending will benefit from renewed interest in capacity expansion, and continued strong earnings will help fuel more ambitious spending programs.

Another important factor is foreign investment, which has been attracted to Canada by the weak Canadian dollar. For example, Daishowa Paper Manufacturing Co. of Japan said recently that it is considering plans to spend up to $1 billion on new capacity in Alberta and British Columbia. More recently, Oji Paper Co. of Japan announced a joint venture with Canfor Corp. to expand market pulp and newsprint capacity at Canfor's Port Mellon, B.C., mill.

Production-related spending plans totaled $6.4 billion for the 1987-89 period, up 49% from plans for the 1986-88 period. Companies reported environmental spending plans totaling $240 million, an increase of 14%.

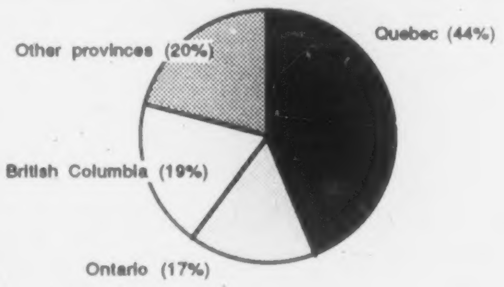
Spending by province. During the past decade, the pattern of provincial expenditures has shifted in focus from western to eastern Canada, although it appears likely to swing back to the west later in the decade. Up until 1982, British Columbia and Alberta led the field in total dollar amounts, capacity expansion, and greenfield mill plans. Since then, spending programs in Ontario and, most recently, in Quebec have eclipsed the western provinces.

ESTIMATED CAPITAL SPENDING BY PROCESS AREA, 1987-89



Source: Pulp & Paper Project Report

PLANNED 1987 SPENDING BY PROVINCE



Source: Statistics Canada

TOP SPENDERS IN CANADIAN INDUSTRY*

	1987-89
Domtar	934,818
Howe Sound Pulp & Paper*	635,000
Consolidated-Bathurst*	575,500
CIP	568,500
Daishowa Paper Manufacturing*	500,000
Ontario Paper*	479,312
Great Lakes Forest Products*	473,010
Alberta Newsprint*	360,000
Tembec*	334,952
Abitibi-Price*	332,500
British Columbia Forest Products*	296,000
Weldwood	285,000
Eddy Forest Products*	280,815
Kruger*	270,000
Weyerhaeuser Canada	202,500
Finlay Forest Industries	198,000
Millar Western Pulp	195,000
Donohue	190,539
Fibreco Export	170,000
Reed	146,000
MacMillan Bloedel	145,600
St. Marys Paper	145,000
Bowater Mersey	128,000
Cascades	125,000
Canfor*	123,720
Crestbrook Forest*	109,695

* Includes programs for completion beyond 3-year period indicated.
Note: All totals include production and environmental programs.

This shift was due to several factors. Weak markets and high production costs dealt a heavy blow to British Columbia companies during the recession, while in Quebec and Ontario, federal aid designed to modernize the industry helped some eastern companies when the economy forced internal cutbacks.

Of the top spenders in *Pulp & Paper*'s 1986 survey, Domtar Inc., Repap Enterprises Corp., Kruger Inc., and Consolidated-Bathurst Inc. all are headquartered in Montreal, and Abitibi-Price Inc. is headquartered in Toronto. Together they accounted for $1.9 billion out of the total of $2.7 billion in production and environmental spending plans announced for Quebec and Ontario in the 1986-88 period. In contrast, expenditures in the western region for both categories during the same period totaled just $206 million.

In 1987, spending programs in the west heated up considerably, as major projects for the 1987-89 period were approved or begun by Champion International Inc., CIP Inc., Finlay Forest Industries Ltd., and Weyerhaeuser Canada Ltd. Newcomers Fibreco Export Inc. and Millar Western Pulp Ltd. began construction of greenfield chemi-thermomechanical pulp plants in British Columbia and Alberta. In late 1987 and early 1988, Japanese producers Daishowa and Oji also weighed in with major expansion programs for these two western provinces, and another newsprint mill was announced for Alberta by Alberta Newsprint Co.

Spending by category. Spending in Canada is up in every process area except energy, with the strongest growth in outlays for new paper machines.

Pulping projects have taken the largest portion of total spending plans in recent years, ranging from a low of 24% in *Pulp & Paper*'s 1985 survey to a high of 37% in the 1987 survey for the period 1987-89. The balance between paper-machine rebuilds and new paper-machine installations swung back in favor of the latter in the 1987 survey. Announced expenditures for new paper machines in the 1987-89 period jumped 107% over the previous year's survey to 33% of total expenditures. This compares with percentages ranging from 5% to 12% annually from 1983 to 1986.

Companies reported plans to spend $896 million on paper-machine rebuilds and modifications in the 1987-89 period, a gain of 19% over the previous year's plans. This was the first increase in several years for paper-machine rebuilds, which fell 18% in 1986 and 21% in 1985. The energy sector was the only process area that did not post large gains for the 1987-89 period. Total outlays were reported at $269 million, virtually the same level as in 1986.

CAPITAL SPENDING PLANS OF MAJOR CANADIAN PAPER COMPANIES

(C$ 000)

	1987	1988e	% change
CIP	C$150,000	C$326,000	117.3%
Eddy Forest Products	21,027	53,233	153.2
Fraser	37,000	101,000	173.0
Great Lakes Forest Products	38,000	184,000	384.2
James River—Marathon	14,667	17,333	18.2
Quebec & Ontario Paper	61,543	92,280	49.9
Soucy	8,000	36,300	353.8
Total	348,297	828,846	138.0

Source: *Pulp & Paper Project Report.*

MERGERS AND ACQUISITIONS

Since just before the beginning of this decade, merger and acquisition activity in the Canadian pulp and paper industry has been largely cyclical, responding to the ups and downs of the general economic climate. The years 1978 through 1981, for example, were characterized by a hectic pace, with the most significant events during that period being the takeovers of Canada's two largest pulp and paper companies, MacMillan Bloedel Ltd. and Abitibi-Price Inc., by outside interests.

The cycle swung back in the opposite direction, however, as the recession of 1982 put a definite halt to takeover activity. During the following two years, only three major ownership changes took place: Crown Zellerbach Corp. sold its Canadian operations to Fletcher Challenge Ltd. of New Zealand; Western Forest Products Ltd. sold its two British Columbia pulp mills to a limited partnership group; and Bowater Corp. of the U.K. spun off its North American assets into Bowater Inc.

Consolidating ownership. The pattern of smaller, more select purchases established in 1983 and 1984 remained in evidence in 1985. Still not fully recovered from the overexpansion of the early 1980s, companies continued to show caution in their spending plans. Canfor Corp., CIP Inc., and Noranda Inc. all consolidated their holdings in 1985 by purchasing the remaining assets of companies in which they already held majority stakes. Meanwhile, Rauma-Repola Oy of Finland, a major supercalendered producer, bought 25% of St. Marys Paper Co. of Ontario as both an entry into the North American marketplace and an avenue for possible future cooperative ventures.

Gulf Canada Ltd.'s purchase of 90% of the stock of Abitibi-Price from real estate developers Olympia & York Developments Ltd. was the one major departure from the round of relatively small-scale deals that took place during 1985. Gulf's acquisition of Abitibi was accomplished in four installments over a period of four months. Its final share of Abitibi was diluted, however, when Abitibi issued additional common shares and common share purchase warrants in April 1986, bringing Gulf's ownership down to approximately 83.4%. Gulf further reduced its Abitibi interest in 1987 as it spun off its share in a major reorganization of its total holdings, which increased the public float of Abitibi shares to 27%.

A bit of controversy accompanied the purchase of ITT Rayonier Inc.'s idle Port Cartier, Que., dissolving pulp mill by Cascades Inc. and Rexfor, the provincial forestry corporation. Plans to approve government funding of a conversion of the mill to chemi-thermomechanical pulp production were criticized by the Canadian Pulp and Paper Assn., which claimed that the government's assistance in the Port Cartier project was unfair to other Canadian producers.

The other major pulp mill purchase of 1985 proceeded uneventfully, as Repap Enterprises Inc. acquired Boise Cascade Canada Ltd.'s Newcastle, N.B., kraft pulp mill. The major significance of this deal was Repap's intent to construct a lightweight coated groundwood mill at the Newcastle site, using part of the pulp mill's output to provide a portion of the furnish needed for the new operation.

More mill sales. The amount of acquisition activity in 1986 did not increase from that of the previous year, although the character of the deals made during the year reflected an increasing level of newsworthiness. As the year progressed, the level of activity increased, with many deals reaching conclusions in 1987. In a joint venture of international scope announced in June 1986, a partnership was formed by Consolidated-Bathurst Inc.; Power Corp. of Canada; and China International Trust & Investment Corp. (CITIC), the investment agency of the People's Rep. China, to purchase Westar Timber Ltd.'s Castlegar, B.C., kraft market pulp mill. The deal was the first major investment made by CITIC, which will hold a 50% share in the mill with the two Canadian companies each holding a 25% share.

Weyerhaeuser Canada Ltd., in a deal reminiscent of

Repap's purchase of the previous year, bought Prince Albert Pulp Co. Ltd. and announced plans to build a new paper mill to produce uncoated free-sheet papers on the site in Saskatchewan. Repap, meanwhile, further expanded its presence in the industry by purchasing Westar Timber Ltd.'s Prince Rupert, B.C., kraft market pulp mill. Westar, with the sales to Repap and the Con-Bath/PCC/CITIC partnership, removed itself from the ranks of Canadian pulp producers.

Major sales in early 1987. The biggest deals

MAJOR CANADIAN PAPER INDUSTRY ACQUISITIONS

Acquiring company	Paper company acquired	Estimated value (C$ millions)
	1983	
Fraser Inc.	50% of Island Paper Mills at New Westminster, B.C.	$25
Fletcher Challenge Ltd.	96% of Crown Zellerbach Canada (since renamed Crown Forest Industries) mill at Campbell River, B.C.	242 (US)
Western Pulp Limited Partnership	Western Forest Products' Port Alice & Squamish, B.C., mills	150
James River Corp. (80%) and Buchanan Forest Products (20%)	Marathon, Ont., mill of American Can	10.5
Cascades Inc.	East Angus, Que., mill of Domtar	n.a.
Employees and outside investors	Bowater's Perkins Papers Ltd. mill at Candiac, Que.	n.a.
	1984	
St. Marys Paper Inc.	Sault Ste. Marie, Ont., mill of Abitibi-Price	n.a.
Cascades Inc.	Jonquière, Que., mill of Abitibi	n.a.
Bowater Inc.	Bowater Canadian Ltd., spun off from Bowater Corp.	57
Kruger Inc.	Bowater Inc.'s Corner Brook, Nfld., mill	n.a.
Cascades Inc.	Manville Corp. of U.S.'s 50% share of Papier Kingsey-Falls mill; balance already held by Cascades	1.2
	1985	
Canfor Corp.	The 25% share of Intl. Pulp Co. Ltd. held by Feldmühle AG	n.a.
Cascades/Rexfor	ITT Rayonier's mothballed Port Cartier, Que., dissolving pulp mill; government financing approved in early 1986	17
CIP Inc.	Completed the acquisition of the 50% of Tahsis Co. Ltd. not already owned	n.a.
Gulf Canada Ltd.	90% of Abitibi-Price Inc. from Olympia & York in four installments; shares reduced to approximately 83.4% after Abitibi stock offering in April 1986	1,200
Noranda Inc.	32% of Fraser Inc. not already owned	60
Rauma-Repola Oy	25% of St. Marys Paper Co.	n.a.
Repap Enterprises Inc.	Boise Cascade Canada Ltd.'s Newcastle, N.B., kraft market pulp mill	90 (US)
	1986	
Cascades Inc.	60-mtpd roofing felt mill at Joliette, Que., from Canadian Gypsum Co. Ltd.; paper machines at Nitec Paper Corp.'s Niagara Falls, N.Y. mill	n.a., 1.75
Consolidated-Bathurst, Power Corp. of Canada, China Intl. Trust & Investment Corp.	Westar Timber Ltd.'s Castlegar, B.C., pulp mill	95
Gordon Investment Corp. and Merrill Lynch Canada Inc.	26.3% stake in BCFP held by Brunswick Pulp & Paper Co. and 15.2% stake in BCFP held by Mead Corp.	n.a.
Paperboard Industries Corp.	Big M Paperboard's Palmyra, Mich., recycled board mill	1.145
Repap Enterprises Inc.	Westar Timber Ltd.'s Prince Rupert, B.C., kraft market pulp mill	110
Waferboard Corp.	Abitibi-Price Inc.'s Smooth Rock Falls, Ont., bleached kraft market pulp mill	45
Weyerhaeuser Canada Ltd.	Prince Albert Pulp Co. Ltd.	248

continued

during the first half of 1987, both in terms of dollar figures and the amount of publicity they engendered, were the sales of Donohue Inc. and British Columbia Forest Products, both of which began during 1986.

It was in the fall of 1986 that the Quebec government offered for sale its shares of both Donohue and Domtar Inc., drawing interest from a large variety of sources. A deal was finally struck in February 1987, when an offer for the Donohue shares, tendered by Quebecor Inc. and British Printing & Communication Corp., was deemed acceptable by the Quebec government. The C$320-million deal for 55.25% of Donohue was completed in July. The Domtar shares, which had appreciated greatly in value since the original offer to sell had been made, failed to find a buyer and remained under Quebec's control for the time.

It was also in February 1987 that Fletcher Challenge of New Zealand made an offer for a 42% interest in BCFP acquired the year before by Gordon Investment Corp. and Merrill Lynch Canada Ltd. Fletcher Challenge eventually acquired a 47% stake in the intial offering, but then in January 1988 it upped its holdings to 67.4% while at the same time completing its buyout of Crown Forest Industries. Together, the two acquisitions give Fletcher Challenge a substantial interest in the Canadian industry, with assets estimated at over $2 billion.

Also in 1987, Paperboard Industries Corp. acquired controlling interest in Belkin Inc. of Vancouver, B.C., in a deal that turned it instantly into Canada's largest recycled paperboard and packaging company. In February 1988, the company was taken private when Kinburn Industrial Corp. raised its stake to 98% from 51.8%.

In mid-1987, Bowater Inc. was prevented from acquiring control of Canadian forms manufacturer, R.L. Crain Inc. The Supreme Court ruling in Ontario upholding multiple voting rights held by the Crain family effectively thwarted the Bowater move.

Another takeover that appeared effectively blocked was Cascades Inc.'s attempt to wrest control of closely held Rolland Inc. from Rolland family interests. Cascades purchased 32% of Rolland's voting stock and another 29% of nonvoting stock in early 1987. Cascades was denied a seat on Rolland's board of directors, however, and the family retained its controlling share in the company.

Foreign investment trend. By late 1987, it became apparent that foreign investment would be a new trend in Canadian pulp and paper investment. It began with an announcement in December 1987 that Oji Paper Co. Ltd. of Japan and Canfor Corp. would form a partnership to acquire

MAJOR CANADIAN PAPER INDUSTRY ACQUISITIONS (continued)

Acquiring company	Paper company acquired	Estimated value (C$million)
	1987	
Abitibi-Price Inc.	Gulf Canada Ltd. spins off its 83% share of Abitibi, increasing the public float of Abitibi shares to 27%	n.a.
Cascades Inc.	Acquires 32% of "Class B" voting stock and 28.7% of "Class A" nonvoting stock of Rolland Inc. in a takeover attempt	4.5
Domtar Inc.	Genstar Corp.'s gypsum wallboard operations	241 (US)
Fletcher Challenge Ltd.	Acquires 47% of British Columbia Forest Products Ltd.	505
Oji/Canfor	Howe Sound Pulp Div.	307.5
Paperboard Industries Corp.	Acquires more than 95% of common shares and more than 92% of nonvoting shares of Belkin Inc.	219.5
Quebecor Inc. and British Printing & Communication Corp.	Purchased the 56% share of Donohue Inc. held by the Quebec government	320
St. Raymond Paper Inc.	Mill president purchases the 60,000-tpy groundwood mill (Chute Panet) from Imperial Trust of Montreal	n.a.
Timber Investments Ltd.	Acquires over 99% of outstanding shares of Balco Industries Ltd.	27
Weldwood of Canada	St. Regis Paper Co. (Canada) from Champion	264
	1988	
Canadian Pacific Ltd.	Merged Great Lakes Forest Products Ltd. with CIP Inc. to form Canadian Pacific Forest Products Ltd.	1,260
Daishowa Paper Manufacturing Co.	Peace River, Alta., greenfield mill	500
Daishowa Paper Manufacturing Co.	Reed International plc's North American Paper Group	650+
Fletcher Challenge Ltd.	Raised stake in BCFP to 67.4% and in Crown Forest to 100%	573
Kinburn Industrial Corp.	Increased share in Paperboard Industries to 98% from 51.8%	72
Olympia & York	Raised stake in Abitibi to about 74.8% as of Jan. 11, 1988	n.a.

n.a. = Not available.

Canfor's Howe Sound Pulp Div. at Port Mellon, B.C., and its Westcoast Cellufibre Industries sawmill and chipping plant in Vancouver. The new company was called Howe Sound Pulp & Paper Co. Ltd. An initial expansion was planned that included additional pulping capacity and a new 200,000-tpy newsprint machine by 1991.

Then in February 1988, Daishowa Paper Manufacturing Co. committed to building a 340,000-tpy bleached kraft market pulp mill near Peace River, Alta. The $500 million project was expected to be completed in 1990, with much of the output marketed in Japan. The federal government agreed to fund C$9.5 million toward "infrastructure," and the province put in C$65.2 million for rail and road access.

The biggest Canadian investment by the Japanese though, was made in mid-1988. Daishowa announced it would buy Reed International plc's North American Paper Group for C$565 million plus an amount equal to after-tax profits earned from Apr. 2 (the end of the 1988 fiscal year) until the deal closed, as well as assumption of an estimated C$66 million in debts.

The deal, which was expected to conclude by late September, included Reed's 432,000-tpy newsprint mill in Quebec City, Que., which also makes 35,000 tpy of boxboard and 20,000 tpy of market sulfite pulp.

The Reed acquisition would make Daishowa one of the largest foreign investors in Canadian pulp and paper, with a 25% interest in the Cariboo Pulp & Paper Co., a 50% share in Quesnel River Pulp Co., and the more recent investment in the Peace River mill. Reed would also be Daishowa's first venture into the eastern Canadian market.

At about the same time, another overseas investor was looking at a Canadian investment. The Kuwait Investment Office (KIO) offered C$200 million to buy 10.3% of Consolidated-Bathurst. Power Corp. of Montreal, Que., which owns 40% of Con-Bath, said it would not tender any of its shares to KIO but would cooperate in a voting trust if KIO's offer was successful. It was not certain if Associated Newspaper Holdings plc of the U.K., with a 15% stake, would sell its shares.

Canadian investment up, too. Acquisition activity from within Canada was also continuing. Early in 1988, Weldwood of Canada Ltd. bought St. Regis Paper Co.

FOREIGN OWNERSHIP OF CANADIAN PULP AND PAPER COMPANIES

Company	% owned	Foreign owner	Assets
Beaver Wood Fibre	100.00%	Georgia-Pacific, U.S.	Paperboard mill, Thorold, Ont.
Boise Cascade Canada	100.00	Boise Cascade, U.S.	Pulp/paper mills, Fort Francis and Kenora, Ont
Bowater Mersey	49.00	*Washington Post,* U.S.	Pulp/newsprint mill, Liverpool, N.S.
	51.00	Bowater, U.S.	
British Columbia Forest Products	67.40	Fletcher Challenge, New Zealand	Two B.C., one U.S. mill; plus other B.C., Quebec mill shares
Cariboo Pulp & Paper	50.00	Champion International,[1] U.S.	Market pulp mill, Quesnel, B.C.
	50.00	Daishowa Marubeni Intl., Japan	
Celgar Pulp	50.00	CITIC B.C., People's Rep. China	Market pulp mill, Castlegar, B.C.
Consolidated-Bathurst	15.00	Associated Newspapers, U.K.	Eight mills
Crestbrook Forest Industries	32.24	Honshu Paper, Japan	Market pulp mill, Skookumchuck, B.C.
	32.24	Mitsubishi Paper Mills Ltd., Japan	
Crown Forest Industries	100.00	Fletcher Challenge, New Zealand	Pulp/paper mill, Campbell River, B.C.
Daishowa Canada	50.00	Daishowa-Marubeni Intl., Japan	Proposed mill
Donohue	27.00	British Printing & Communication[2], U.K.	One pulp/paper mill, plus holdings in two others
Donohue-Charlevoix	44.66	Gannett, U.S.	One machine, Clermont, Que.
Donohue-Malbaie	35.00	*New York Times,* U.S.	One machine, Clermont, Que.
Eurocan Pulp & Paper	50.00	Enso Forest Products (Enso-Gutzeit Oy), Finland	Pulp/paper/paperboard mill, Kitimat, B.C.
	50.00	West Fraser Timber, U.S.	
Finlay Forest Industries	14.00	Jujo Paper, Japan	Market pulp mill, Mackenzie, B.C.
Gaspesia Pulp & Paper	49.00	*New York Times,* U.S.	Pulp/newsprint mill, Chandler, Que.
Glassine Canada	100.00	Simkins Industries, U.S.	Paper mill, Quebec City, Que.
Howe Sound Pulp & Paper[3]	50.00	Oji Paper, Japan	Joint venture
James River-Marathon	80.00	James River, U.S.	Market pulp mill, Marathon, Ont.
Kimberly-Clark of Canada	100.00	Kimberly-Clark, U.S.	Four pulp or paper mills, Ontario
NBIP Forest Products	25.00	Oji Paper Co., Japan	Pulp/newsprint mill, Dalhousie, N.B.
	8.00	Mitsui, Japan	
Northwood Pulp & Timber	50.00	Mead, U.S.	Market pulp mill, Prince George, B.C.

continued

(Canada) Ltd. from Champion International Corp. in exchange for 16.5 million Weldwood shares, giving Champion an 84.6% ownership in Weldwood. This gave Weldwood control of the 182,000-tpy bleached softwood kraft market pulp mill in Hinton, Alta.

At about the same time, Olympia & York announced it had acquired another 1.5 million common shares of Abitibi-Price, raising its stake to about 74.8% of the company's common shares as of Jan. 11, 1988.

While acquisitions were proceeding at a hectic pace throughout the country, others were looking for buyers. One was Manfor Ltd. After several attempts to sell the company in The Pas, Man., earlier in 1980, it was again put on the block by the province of Manitoba in January 1988. Unlike prior attempts, the company felt the 150,000-tpy unbleached kraft market pulp and paper mill's improved financial condition and better markets for *its* products would lead to a sale. Conditions placed on the sale by the government—such as further investment, employment, and use of resources—could be restrictive.

The most recent and one of the biggest ownership upheavals of 1988 was the merger of Great Lakes Forest Products Ltd. with CIP Inc., creating the second largest North American producer of pulp and newsprint. In June, shareholders approved the joining of the two Canadian Pacific Ltd. subsidiaries. The newly formed company, called Canadian Pacific Forest Products Ltd., was headquartered in Toronto, Ont. CP's 54.3%-held GLFP unit issued about 24.4 million common shares to CP in exchange for all of the shares of the wholly owned CIP, giving CP about 79.9% of the merged company in a deal valued at $1.26 billion.

FOREIGN OWNERSHIP OF CANADIAN PULP AND PAPER COMPANIES (continued)

Company	% owned	Foreign owner	Assets
Ponderay Newsprint	60.00%	Consortium of five newspaper publishers, U.S.	Proposed newsprint mill, Usk, Wash.
Procter & Gamble Cellulose	100.00	Procter & Gamble, U.S.	Market pulp mill, Grande Prairie, Alta.
Quebec & Ontario Paper	100.00	The Tribune, U.S.	Pulp/newsprint mills, Baie Comeau, Que.; Thorold, Ont.
Quesnel River Pulp	50.00	Daishowa Canada, Japan	Market pulp mill, Quesnel River, B.C.
	50.00	West Fraser Mills (West Fraser Timber), U.S.[4]	
Reed Paper	100.00	Reed International, U.K.[5]	Pulp/paper/paperboard mill, Quebec City, Que.
St. Anne Nackawic Pulp & Paper	100.00	Parsons & Whittemore, U.S.	Market pulp mill, Nackawic, N.B.
St. Marys Paper	25.00	Rauma-Repola, Finland	Pulp/paper mill, Sault Ste. Marie, Ont.
Scott Paper Ltd.	50.00	Scott Paper Co., U.S.	Pulp/paper mills in B.C., Quebec
Scott Maritimes	100.00	Scott Paper Co., U.S.	Market pulp mill, Abercrombie Point, N.S.
Sonoco Ltd.	100.00	Sonoco Products Co., U.S.	Paperboard mill, Brampton, Ont; Terrebonne, Que.
F.F. Soucy	100.00	Brant-Allen Industries, U.S.	Pulp/newsprint, Rivière-du-Loup, Que.
F.F. Soucy et Associés	50.00	Brant-Allen Industries, U.S.	Paper mill, Rivière-du-Loup, Que.
	40.00	Dow Jones, U.S.	
Spruce Falls Power & Paper	50.50	Kimberly-Clark, U.S.	Pulp/paper mill, Kapuskasing, Ont.
	49.50	*New York Times*, U.S.	
Stora Forest Industries	100.00	Stora, Sweden	Pulp/newsprint mill, Port Hawkesbury, N.S.
Weldwood of Canada[6]	84.60	Champion International, U.S. (see Cariboo Pulp & Paper)	Market pulp mill, Hinton, Alta.
Weyerhaeuser Canada	100.00	Weyerhaeuser Paper, U.S.	Market pulp mills, Kamloops, B.C.; Prince Albert, Sask.

1. Through Weldwood of Canada.
2. Mircor Inc. was set up to buy 55.25% of Donohue stock from Dofor (a government body). British Printing owns 49% and Quebecor owns 51% of Mircor.
3. Proposed venture combining existing Howe Sound Pulp Div. and Oji investment in a newsprint mill.
4. West Fraser Timber Co. is majority-owned by Ketcham family of U.S.
5. Pending sale to Daishowa in mid-1988 of Reed's North American Paper Group.
6. Weldwood acquired 100% of Champion Forest Products (Alberta) Ltd.'s mill at Hinton, Alta., early in 1988, at which time Champion's interest in Weldwood increased from 71.8% to 84.6%.

LABOR

In British Columbia in July 1988, the Canadian Paperworkers Union (CPU) and Pulp & Paper Workers of Canada (PPWC) voted 71% in favor of a three-year agreement that called for an C85¢/hour increase in the first year and a 5.5% hike in both the second and third years, bringing the average straight-time wage rate to C$20.075/hour on July 1, 1990.

The settlement was considerably higher than one reached in 1987 by most mills in eastern Canada, which called for wage hikes of 25¢/45¢/4.5% over three years expiring Apr. 30, 1990. If British Columbian producers had settled for a similiar schedule of increases, the two regions' wage rates would have been closer together. This new settlement, however, widened the gap. By mid-1989, the base wage rate in the East will be about C$15.67/hour compared with C$16.17/hour in the West. In 1987, the rates were C$14.36 in the East and C$14.48 in the West.

In comparison with agreements being negotiated in the U.S., the settlement was also somewhat high. Mills in the Pacific Northwest were settling for wage increases of 4% or less. And if the Canadian dollar continues to go up, Canadian mills will be at even more of a competitive disadvantage to their neighbors to the south.

"In terms of the Pacific Northwest, we think we had a bit of an advantage and retain that advantage in the 1988-89 period," said Eric Mitterndorfer, president of the Pulp & Paper Industrial Relations Bureau (PPIRB) in Vancouver, B.C. "But what happens beyond that will have a lot to do with what they do in their contracts and with what the currency exchange rates do.

"If the currency changes work against us, we could be saying somewhere down the road we should have done something different. Today, it's probably not too bad," he added. Mitterndorfer was chief negotiator for the industry,

CANADIAN PAPER WORKERS UNIONS

Union	Region represented	Number of members	Number in primary pulp and paper
United Paperworkers International Union (UPIU)	Canada	2,350	n.a.
Canadian Paperworkers Union (CPU)	Canada	67,695	43,515
	Maritimes	13,518	8,356
	Quebec	22,857	13,596
	Ontario and Manitoba	20,981	13,540
	Saskatchewan, Alberta, and British Columbia	10,339	8,023
Pulp & Paper Workers of Canada (PPWC)	Western Canada	7,200	5,500

n.a. = Not available.

Pulp and paper workers are also represented in Canada by such major unions as the Confederation of National Trade Unions, International Assn. of Machinists & Aerospace Workers, International Brotherhood of Electrical Workers, and others.

which retains PPIRB as its bargaining agent in British Columbia.

Industry observers expected the benefits package to add another 1.5% annually to the cost of the agreement. All told, the new labor contract was expected to run the industry 20% or more in additional labor expenses over the next three years.

In terms of pensions, the contract contains a bridging formula worth C$15/month per year of service that will make pensions at age 63 comparable to what workers are now getting at age 65. In eastern Canada, workers with 20 years of service are eligible to retire at age 58.

"Most of us expected an average annual increase of 4% or 4.5% as being reasonable," said Richard A. Kelertas, paper and forest products analyst with ScotiaMcLeod Inc. (formerly McLeod Young Weir), Toronto, Ont. "Now, it will be double. You'll see some earnings problems, especially in 1989 when there will be a full-year effect."

Ross Hay-Roe, editor of *PaperTree Letter,* noted that the agreement seems somewhat costly given the fact that Canadian inflation is running at about 4%/year. But he did not expect it to affect the industry's bottom line dramatically. He considered the contract overall to be positive because it demonstrated to customers that the industry's labor relations have improved and because it provides for three years of stability.

After decades of labor negotiations marred by work stoppages, this marked the second consecutive contract the British Columbian industry has reached without any major disruptions. "There's been an effort by the companies to tell their side, educate the workers. And, it's starting to pay off," said Jim Rowland, editor of *Canadian Paper Analyst,* Westmont, Que.

"Since early 1984, we've been without any labor disruptions," said Mitterndorfer. "Particularly now [July 1988], when supplies are a little short, our customers are happy they didn't have to scramble around. And, we're hoping they remember it when things turnaround."

Another observer felt the settlement was probably the best the industry could have hoped for. With profits up substantially since 1986, the unions wanted to share some of the wealth. And the industry was anxious to keep the mills running as long as business remained good. Some industry analysts are forecasting a downturn as early as 1989 and possibly sooner.

Other observers thought the industry could have held out longer for a better settlement that would have cost them less over the long haul, even if it had meant a strike. "I think they're taking long-term pain for short-term gain, when it should have been the other way around," said Kelertas.

About 11,500 union workers working at 21 pulp and paper mills in British Columbia are covered by the latest three-year contract. Five of the past nine contracts in British Columbia were reached only after strikes.

The settlement in the pulp and paper mills set the pattern for a new contract with woodworkers in British Columbia, represented by the International Woodworkers

CANADIAN PULP & PAPER EMPLOYMENT AND EARNINGS

			Yearly change		% change	
	Employees	Salaries/ wages	Employees	Salaries/ wages	Employees	Salaries/ wages
1986e	77,500	2,850,000	–62	39,199	–0.1%	1.4%
1985	77,562	2,810,801	–1,842	171,996	–2.3	6.5
1984	79,404	2,638,805	240	110,451	0.3	4.3
1983	79,164	2,528,354	–3,940	86,228	–4.7	3.5
1982	83,104	2,442,126	–4,778	132,324	–5.4	5.7
1981	87,882	2,309,802	1,010	260,059	1.2	12.7
1980	86,872	2,049,743	–179	202,615	–0.2	11.0
1979	87,051	1,847,128	1,450	150,359	1.7	8.9
1978	85,601	1,696,769	1,068	155,414	1.3	10.1
1977	84,533	1,541,355	–2,462	125,511	–2.8	8.9
1976	86,995	1,415,844	2,949	324,168	3.5	29.7
1975	84,046	1,091,676	–2,157	–5,422	–2.5	–0.5
1974	86,203	1,097,098	6,118	212,856	7.6	24.1
1973	80,085	884,242	1,116	75,373	1.4	9.3
1972	78,969	808,869	–428	63,261	–0.5	8.5
1971	79,397	745,608	–974	44,213	–1.2	6.3
1970	80,371	701,395				
Average						
1981-84			–1,867	147,016	–2.2	6.6
1976-80			565	191,613	0.7	13.7
1971-75			1,162	86,517	1.5	10.3

Source: *Statistics Canada.*

Assn. (IWA)-Canada. In August 1988, about 18,000 members of IWA-Canada ratified a three-year contract with increases of 85¢/hour in the first year and a 5.5% increase in each of the remaining two years. The settlement affected about 80 companies in British Columbia and covered workers in sawmills, logging operations, and wood manufacturing. It was retroactive to June 15, 1988, and it lifted the base wage rate from C$14.80 to about C$15.65/hour in 1988.

Negotiations in 1988 were more amenable than those in 1986, when the woodworkers struck for four-and-a-half months. The strike was over shift flexibility and contracting out. In the 1988 contract, the union agreed to allow the industry to adjust work schedules outside of strict time frames without paying overtime or dealing with other impediments. In return, the industry agreed not to contract out work without first consulting the union and determining whether the work can be performed by union members.

Employment. Wages and salaries in the Canadian pulp and paper industry increased an average of 10.3%/year during the early 1970s. Employment rose during the period at a 1.5% annual pace, or just under 1,200 new workers each year. As inflation climbed in the late 1970s, wage increases picked up to a 13.7%/year pace. Employment slowed to a 0.7% annual rate, however, as new technology cut into personnel requirements.

With the back-to-back recessions of the early 1980s and the subsequent collapse of inflation, the 1981-84 period brought hard times to the industry. Wage and salary increases slowed from 12.7% in 1981 to only 4.3% in 1984, while employment shrank 2.2%/year during the period. Nearly 9,000 workers lost their jobs during the 1982-83 downturn, as employment contracted over 10%. To put that number into perspective, the severe recession of 1975 caused a mere 2.5% reduction in employment, according to *Statistics Canada*.

Bargaining pattern. Unions in the Canadian pulp and paper industry tend to wield more power in bargaining than their U.S. counterparts because of a highly centralized bargaining pattern. Unions also benefit from certain prolabor government policies, such as one prohibiting companies from operating mills during walkouts. However, recent contract settlements indicate that the Canadian unions are scaling back their demands in view of the industry's willingness to take downtime rather than agree to costly contracts.

The bargaining focus in Canada usually alternates between the East and West. Until 1984, both regions tended to negotiate two-year contracts expiring in the West in odd years and in the East in even years. In 1984, however, both regions approved three-year contracts, with the West's agreement expiring in 1986 and with most contracts in the East lapsing in 1987.

In July 1988, the West concluded a three-year contract that expires in 1990. In first-half 1987, most mills in the East concluded three-year contracts that lapse in 1990.

On the West Coast, most companies belong to bargaining groups called Forest Industrial Relations Ltd. and PPIRB, which act as industry-wide bargaining agents. The former group bargains for the timber sector of the industry, while the latter handles paper industry negotiations. In eastern Canada, the industry does not bargain collectively except for four companies—Domtar Inc., Reed Inc., Quebec & Ontario Paper Co. Ltd., and James Maclaren Industries Inc.—which refer to their consortium as the Eastern Canadian Newsprint Group.

Canadian unions. The largest union in the Canadian pulp and paper industry is CPU, which has about 68,000 workers. About 13,500 of those members work in the Maritime provinces, 22,850 in Quebec, 21,000 in Ontario and Manitoba, and 10,300 in the West.

Another major Canadian union, PPWC, has about 7,200 members, most of them in British Columbia. The United Paperworkers International Union (UPIU), the majority of whose membership is in the U.S., also represents approximately 2,350 workers in Canada. CPU broke off from UPIU in the 1970s.

It is possible that IWA, Canada's major union covering timberland and sawmill workers, will merge with either CPU or PPWC. In 1986, the Canadian part of IWA dissolved the international union by voting to split with the U.S. section. Prior to the vote, IWA-Canada had merged its western and eastern locals into a group that comprised 64% of the total 70,000 members in the international union. The split reflected the diverging interests of the U.S. and Canadian groups. For example, the U.S. unions negotiated concessions that the Canadian workers resisted. The Canadian workers were also uneasy about the U.S. countervailing duty on softwood lumber, which U.S. locals reportedly favored.

Traditionally, Canadian unions have staged prolonged strikes, ranging from several weeks to several months, in order to attain contract demands. In 1981, a six-week strike by 60,000 members of CPU, PPWC, and IWA shut down the entire British Columbian forest products industry. The strike cost companies an estimated C$18 million/day in sales revenue while employees lost in excess of $8 million/day in earnings.

In the 40 years prior to 1981, the West Coast had been hit by five other industry-wide strikes, two of these staged by pulp and paper unions and lasting three months each. IWA struck its industry an additional three times.

In eastern Canada, the industry's unions have usually targeted a major company with which to work out a labor contract and then have used it as a role model in negotiations with other companies bargaining that year. Because it is the largest paper company in eastern Canada, Abitibi-Price Inc. traditionally has been the union's target. In 1975, Abitibi mills were closed during a seven-month strike by CPU. In 1980, the union again struck Abitibi, but for only five weeks. That same year, Domtar mills were struck for seven months.

In 1982-83, unions were forced to rethink their tactics as company bargaining clout increased due to the mounting need to curtail costs. In 1984, after nearly a year of bargaining and little progress toward reaching an agreement, the British Columbian industry locked out the unions for two months, proving it was more willing to take downtime than sign a high-cost contract. The government had to intercede, and a three-year contract was later signed that provided for a one-year wage freeze and pay hikes of 4%/4.5% in the remaining two years.

At about the same time British Columbia's unions ratified their contract, eastern Canadian bargaining began. Realizing the West Coast settlement would impede any labor grandstanding in the East, CPU leaders were modest in their demands compared with previous years. By summer of 1984, CPU and Abitibi had reached an agreement, without any labor problems, calling for pay hikes of 2.5%/4%/5% over three years.

Labor's more amenable approach to bargaining actually began in 1982. The target that year, Abitibi, informed its employees as the year progressed that its earnings were deteriorating because of the recession. Communicating with its employees paid off when talks were concluded without a strike, and union members voted to accept a two-year contract calling for wage increases of 12% the first year and 10% the second year, despite recommendations from CPU leaders to reject the offer. CPU initially sought wage increases of 40% over a two-year period and later reduced its demand to a minimum of 28% in an attempt to at least reach parity with wages paid to West Coast workers.

A year earlier, CPU had succeeded in forcing an agreement in the East that was particularly burdensome to the industry. The 1981-83 contract called for a 15% wage increase in the first year and a 13% hike in the second. When the economy weakened and earnings began to plummet, companies asked unions to freeze wages for six months, but the request was rejected. At the time, unemployment in sawmills reached 25%.

Recent contract settlements. The main thrust of the bargaining has been job security. Throughout Canada and the U.S., unions are trying to win no-layoff clauses in order to restrict employers' freedom to dispense with jobs. Other items on the union agenda are curbs on contracting out work, early retirement programs that will help preserve the jobs of younger workers, better severance pay, shorter work weeks, and improved retraining programs.

In 1986, CPU and PPWC bargained as a unit in British Columbia, representing about 11,000 members in the province. PPIRB acted as the bargaining agent for the province's pulp and newsprint producers, with the exception of Westar Timber Ltd. Westar withdrew from the Bureau in December 1985.

The two-year contract hashed out by the two sides yielded very modest increases for the unions—0% in the first year and 3% in the second. While CPU ratified the contract by a 58% majority, PPWC demanded a recount of the vote because the agreement passed by only 50.6%. The vote was so close because some locals were dissatisfied with the flexibility language contained in some of these agreements. Among the mills that included stipulations for more flexible work rules were MacMillan-Bloedel Ltd.'s Nanaimo, B.C., mill and Weyerhaeuser Co.'s Kamloops, B.C., mill.

Besides this settlement, the biggest labor action in Canada in 1986 was a strike in British Columbia by members of IWA. The five-month strike is believed to have cost the forest products industry in the province about C$10 million/day. The walkout shut down logging operations and sawmills and slowed operations at some pulp and paper mills. It also forced mills to look farther south to fulfill woodchip requirements.

The major problem, in the minds of IWA members, was the contracting out of logging services and flexible work shifts. British Columbia's provincial government tried to solve the problem with mediation, but it was not until the Truck Loggers Assn. (a group of small- and medium-size independent logging operators) stepped in that the two sides came to an agreement. Both labor and management agreed to discuss the issues of flexible work shifts and contracting out work in public hearings before a Royal commission.

This body issued a report in early 1988, a few months before negotiations on the new contract were due to begin. The commission advised companies that they should not contract out work capable of being perfomed reasonably by IWA on a cost-effective basis. The commissioner also recommended that IWA be more flexible in its work rules and that companies should have the right to unilaterally schedule shifts subject to certain conditions. The subsequent contract settlement incorporated these suggestions.

Other labor action in British Columbia included a one-day strike by the CPU and PPWC in June 1987, which cost the forest industry an estimated C$32 million. The strike was called by the British Columbia Federation of Labor to protest a proposed bill that would give employers and government broader powers to intervene in labor negotiations. The attorney general for the province tried to get a court injunction to outlaw strikes that protest legislative action; the request was turned down by the British Columbia Supreme Court.

In the East, CPU and Abitibi came to an agreement in the summer of 1987 without any work stoppages. By a substantial margin, CPU accepted a new three-year contract with Abitibi that called for wage increases of 25¢/hour the first year, 45¢ the second year, and a 4.5% increase in the third year. The agreement covers 6,000 CPU members employed in nine Abitibi mills in Ontario, Quebec, and Newfoundland. The union originally wanted a two-year contract with a 7.1% wage increase in the first year and an 8.0% increase in the second year.

Under the new agreement, an employee with 20 or more years of continuous service may retire at age 58 with no reduction in pension credits. The age had previously been 61. However, the contract provides for a moratorium on pension discussions in 1990 negotiations.

Despite the rapid settlement of the Abitibi contract, there were some short strikes over local issues at mills owned by Consolidated-Bathurst Inc., Donohue Normick Ltd., and CIP Inc. These actions made newsprint supplies even tighter in Canada, where mills were already running at about 98% of capacity. Fortunately for publishers, the Eastern Canadian Newsprint Group reached an agreement with CPU in June 1987 that is almost identical to the Abitibi contract.

TIMBER RESOURCES AND PULPWOOD CONSUMPTION

About 80% of the land in the ten Canadian provinces is classified as "forested," and forests account for at least half of every province's land. Forest ownership is about 90% provincial, 8% private, and 2% federal (mostly national parks, defense lands, and Native American property). High-quality softwood trees account for about 72% of Canada's salable timber, while mixed wood amounts to 18% and hardwoods to 10%.

Despite these impressive statistics, Canada's timber harvests are declining. F.L.C. Reed of the Canadian Forestry Service estimated that about one-quarter of Canada's forests are incapable of providing timber in a reasonable amount of time. Of the three-quarters of forest that is productive, about one hectare in nine is not satisfactorily restocked, either because the trees do not regenerate after harvest or because pests and fires have depleted the stands. Another 10% to 20% of this land cannot be logged because of environmental and logging guidelines. Still more trees are "economically inaccessible" (i.e., it costs too much to log them).

Based on all of these limitations, Reed and others estimated that as much as half of Canada's forest is "de facto wilderness." For example, British Columbia estimated that about 49% of its timberland is productive.

An examination of annual allowable cut (AAC)—the volume of roundwood that may be harvested yearly from a forest on a sustainable basis—highlighted the decline in forest reserves. Reed estimated that in the late 1970s, AAC was 256 million m^3, falling to 228 million m^3 in 1981. AAC was down to 204 million m^3 in 1986 (166 million m^3 were softwood). This represents roughly a 20% decline in AAC in the last ten years.

Prime sawlogs are in short supply on the coast of British Columbia, in Saskatchewan, and in parts of central Canada. Reed predicted at least a 10% reduction in sawed lumber output in the next ten years. He recommended accelerated forest renewal, better tree protection, and improved wood utilization to ameliorate the problem.

A study conducted by the Univ. of British Columbia's Forest Economics & Policy Analysis Project in late 1987 also drew some alarming conclusions. The study found that logging companies on the coast of British Columbia will run out of virgin timber in about 17 years if they continue to cut trees at current rates. Specifically, loggers on the coast are running out of trees that are economical to cut (i.e., that are accessible and that can be harvested at a profit). The study concluded that only 26% of the remaining stock of mature timber on the coast can be logged economically. It suggested that government and industry

CANADIAN PULPWOOD CONSUMPTION

(000 m^3)

Year	Roundwood	Total wood residue	Total wood
1987	42,107	56,431	98,538
1986	46,842	46,664	93,505
1985	44,115	45,180	89,295
1984	42,597	44,204	86,801
1983	39,755	43,353	83,108
1982	38,926	37,015	75,941
1981	44,717	39,669	84,386
1980	44,462	41,674	86,136
1979	44,910	41,054	85,964
1978	43,824	37,590	81,414
1977	42,042	33,913	75,955
1976	42,056	34,840	76,896
1975	39,503	24,056	63,559
1974	50,858	30,301	81,159
1973	47,795	27,986	75,781
1972	46,516	23,891	70,407
1971	45,245	20,968	66,213
1970	48,339	17,387	65,726

Source: *Statistics Canada.*

should determine how much profitable timber is left. They should then gradually lower the annual timber harvests over the next 20 years in order to spread out the old growth timber until the new forest is ready to cut.

Declining forest reserves are of concern to the entire country because the forest-products industry plays such a pivotal role in the economy. A report released by the Canadian Forest Service in early 1988 used data from *Statistics Canada* to estimate the impact of forestry activity on the nation's economy. The study found that in 1980, an estimated 532,000 jobs in other sectors of the Canadian economy were associated with the 302,000 jobs in the forest sector. This means that 834,000 jobs, or 7.8% of all the jobs in Canada, were due to forestry activity. Between 1980 and 1984, 34,000 jobs were lost from the forest sector, which caused a loss of 60,000 jobs in other sectors of the economy.

Some solutions. The provinces have stepped up forest-regeneration efforts. In the last five years, Ontario has achieved a 69% increase in nursery production, a 122% increase in planted area, and a 64% increase in site preparation area. Ontario has also spent a considerable amount of money to protect its forests from the large-scale fires that plagued the province in the late 1970s and early 1980s, including use of large aerial water tankers and computerized detection systems.

Ongoing problems in Canada are spruce and jack pine budworms. The spruce budworm causes a loss of 45 million m^3 of wood each year in Canada. The forest industry is trying to contain the infestation with biological insecticides, since chemical spraying has been prohibited in many areas.

In order to make better use of its resources, Canadian firms are making more mechanical pulp, which gives twice the yield of chemical pulp. More hardwood is also being pulped. While almost all of the softwood timber that is economical to pulp has been spoken for, a large amount of hardwood has not been claimed yet.

Another discernible trend is that mills are trying to ensure wood supplies by either integrating with sawmills or moving to areas with abundant trees. For example, Fibreco Export Inc., a chip export company formed by sawmills in interior British Columbia, announced that it would build a bleached chemi-thermomechanical pulp mill at Taylor, B.C., next to large poplar stands. Also, Daishowa Paper Manufacturing Co. plans to construct a C$500-million, 340,000-metric-tpy hardwood pulp mill at Peace River, Alta. The mill will use aspen for furnish, and it will be Canada's largest hardwood pulp mill when it starts up in 1990.

Softwood exports. An estimated 83% of logging industry production depends on forest-product exports. British Columbia is one of the provinces that receives the least spinoff effect per volume of wood harvested. Canada exports approximately US$3 billion worth of softwood lumber annually to the U.S. In October of 1986, the U.S. International Trade Administration imposed a 15% ad valorem duty on softwood lumber shipped from Canada to the U.S. Lumber producers in the U.S. had claimed for some time that the fees Canadian lumber companies paid to provinces for cutting timber were too low and that the government was essentially subsidizing the producers.

The U.S. dropped the duty when the Canadian federal government imposed a 15% export fee on its softwood lumber exports to the U.S. The fee was gradually eliminated as the provinces increased stumpage fees for logs cut on government land. Despite the duty and the stumpage fees that followed, the volume of Canadian lumber shipped to the U.S. was relatively unchanged from 1985 levels. (Shipments in 1986 were affected by the woodworkers strike). This was due largely to the strong demand for lumber in the U.S. as well as to the fact that Canadian producers began seeking out segments of the U.S. market they might not otherwise have approached. Therefore, even though wood from California, Oregon, Washington, and the southeastern U.S. was sold in Ontario and British Columbia for less than Canadian lumber in some cases, Canada maintained its market share in the U.S. in 1987. In 1988, Canadian sawmills will reap the benefits from rail rates that were deregulated early in the year, making it less expensive for their products to reach the U.S. market.

Canadian timber is managed for the benefit of the

PULPWOOD RECEIPTS FROM ALL SOURCES, 1987

(000 m^3)

Province/area	1987	% of total
Atlantic provinces	10,147	22.3%
Quebec	12,437	27.3
Ontario	12,722	27.9
Prairie provinces	4,012	8.8
British Columbia	6,221	13.6
Total	45,539	100.0%

Source: *Statistics Canada.*

CONSUMPTION OF PULPWOOD AND WOOD RESIDUE, 1987

(000 m^3)

Province/area	1987	% of total
Atlantic provinces	13,515	13.7%
Quebec	27,942	28.4
Ontario	17,626	17.9
Prairie provinces	6,505	6.6
British Columbia	32,950	33.4
Total	98,538	100.0%

Source: *Statistics Canada.*

province in which it grows, so every province has a different fee system. Unlike the U.S., where a national agency, the U.S. Forest Service, manages and sells federal timber for income, Canada's provinces mandate their own timber policy.

The mills in British Columbia have been particularly vociferous in their opposition to the stumpage fee system because they say the province's system does not affect all producers equally. (British Columbia accounts for 60% of the Canadian wood that enters the U.S.) The cost to some sawmill operators has increased tenfold because of the fee, but others see their costs declining. British Columbia's system emphasizes timber quality and not the end products.

The shoe is on the other foot when it comes to trade with Japan. In first-quarter 1988, Canada asked the Council of the General Agreement on Tariffs & Trade to establish a panel to consider a Canadian complaint against Japan alleging that Japan's tariffs discriminate against Canadian lumber in favor of U.S. lumber. Exports to Japan of Canadian spruce, pine, and fir are subject to an 8% tariff, while exports from the U.S. of competing species enter duty-free.

According to figures published by *Statistics Canada*, mills' pulpwood receipts from all sources amounted to 45.54 million m^3 in 1987, slightly below the 1986 level of 45.81 million m^3. Of this total, the Atlantic provinces accounted for 22.3%; Quebec, 27.3%; Ontario, 27.9%; the prairie provinces, 8.8%; and British Columbia, 13.6%.

In 1987, receipts of woodchips and wood residue at Canadian mills totaled 56.43 million m^3, a 20.9% increase over 1986. Of this amount, mills in the Atlantic provinces accounted for 5.9%; Quebec, 29.7%; Ontario, 9.5%; the prairie provinces, 4.3%; and British Columbia, 50.5%.

Consumption of pulpwood and wood residue in Canada in 1987 amounted to 98.54 million m^3. This is 5.4% above 1986 levels. The Atlantic provinces used 13.7%; Quebec, 28.4%; Ontario, 17.9%; the prairie provinces, 6.6%; and British Columbia, 33.4%.

ENERGY USE AND CONSERVATION

Thanks in part to record production levels, Canadian pulp and paper mills used 33.2% less purchased energy per ton of output in 1987 than in 1972, the base year established for comparison purposes by the Canadian Pulp & Paper Assn. Production increased 34.1% over 1972 levels. In 1987, Canadian mills shipped 5.8% more pulp and 5.4% more paper than in 1986, and they operated at a record 98% of capacity, with only small production losses due to work stoppages.

Conservation efforts. The oil price shocks of the early 1970s led mills to explore virtually every avenue for relief from skyrocketing energy costs. These efforts, which continued into the 1980s despite lower energy prices, led in two basic directions: process improvements to reduce the energy needed to manufacture a ton of product and alternative energy sources to reduce mills' dependence on purchased power.

Process improvements have included more efficient pressing and drying equipment for paper machines, new heat-recovery equipment, and more efficient refiners. On the alternative-energy side, mills have been very successful in exploiting waste products as a source of fuel. Woodwaste now accounts for 68% of the total fuel burned by the industry, while wastefuels plus captive hydraulic power account for 57% of the total energy used, an increase of 42% from 1972.

Consumption patterns. Electricity, natural gas, and heavy fuel oil are the three major forms of energy bought

PURCHASED ENERGY USE IN CANADA

(gigajoules per metric ton of paper produced)

Year	Electricity	Heavy fuel oil	Distillates	Natural gas	Coal	Other*	Total
1986	6.1	2.9	0.2	3.3	0.2	0.1	12.8
1985	5.9	3.2	0.3	3.4	0.4	0.0	13.2
1984	5.7	3.6	0.3	3.5	0.4	0.0	13.5
1983	5.0	4.5	0.2	3.5	0.5	0.1	13.8
1982	5.0	5.6	0.3	4.0	0.5	0.2	15.6
1981	4.8	5.9	0.3	3.9	0.4	0.2	15.5
1980	4.5	6.0	0.4	3.9	0.5	0.2	15.5
1979	4.4	6.5	0.4	4.0	0.5	0.1	15.9
1978	4.7	7.0	0.3	3.9	0.6	0.2	16.7
1977	4.7	7.4	0.4	4.2	0.6	0.3	17.6
1972	4.5	9.0	0.3	3.8	0.7	0.2	18.5

* Purchased steam plus propane.

Source: Canadian Pulp & Paper Assn.

by Canadian mills, accounting for 97.7% of total purchases in 1987. Electricity accounted for 47.9% of energy purchases in 1987, up from only 24.1% in 1972. Over the same period, oil purchases plummeted 69.3%, from a 51.1% share of the total in 1972 to only 24.0% in 1987. The CPPA reported that the reduction in heavy fuel oil use was equivalent to 3.98 billion liters in 1987; in terms of total purchased energy, the reduction was equal to about 3.78 billion liters of heavy fuel oil. Natural-gas purchases have been steadier, rising from 20.1% of the total in 1972 to 25.9% in 1987.

Consumption of electricity continues to climb. Hydro-Quebec's industrial discount program has encouraged increased use of electric boilers in Quebec, and process changes in pulping, air-pollution control, and mechanical paper drying have increased mills' motive power requirements throughout Canada.

Patterns of energy consumption differ widely for the Canadian industry's two main products, bleached kraft market pulp and newsprint. According to the Canadian Energy Research Institute, about 70% of the energy needed to make kraft pulp is supplied by process waste and woodwaste, while 3% is purchased electricity. In contrast, purchased energy accounts for over 40% of the energy needed to produce newsprint, and under 20% is recovered in the form of combustible wastes.

In the pollution-control category, the mechanical pulping process avoids the need for recovering and monitoring the sulfur and chlorine now used in chemical pulping. However, the energy needed for mechanical pulping (debarking, chipping, and grinding) is almost all electricity. Mechanical pulp plants are gradually replacing sulfite pulp mills in Canada, particularly in the newsprint sector.

Newsprint can be made entirely from thermomechanical pulp, eliminating the 20% fraction of chemical pulp that formerly went into the furnish. The thermal energy required for thermomechanical pulping, like the mechanical component, is now generally supplied by electricity. In the future, however, the energy requirement may be provided by grinders that can deliver pressurized steam generated by the grinding process itself.

Spending plans. Many energy-conservation projects were killed or postponed during the recession of the early 1980s, and mills have been slow to restore those programs. Lower fuel-oil costs have made such projects less urgent than they were in the late 1970s. CPPA expects the goal set for 1990 of a 33% reduction in purchased energy per ton of production to be reached, as it was in 1987.

CANADIAN PAPER INDUSTRY CAPITAL SPENDING ON ENERGY AND POWER PROJECTS, 1987-89*

Region	Expenditures (C$000)	% of total energy/power capital budgets
Maritimes	C$23,000	9.0%
Quebec	90,680	34.0
Ontario	28,015	10.0
Central	0	0.0
West	127,661	47.0
Total	269,356	100.0

% of total capital spending, all purposes 4.0%

* Includes projects, as announced, for 1989 and beyond.

Source: *Pulp & Paper* January 1988 Capital Spending Survey.

CANADIAN PULP AND PAPER INDUSTRY PURCHASED ENERGY CONSUMPTION

Energy source	1972[1] joules x 10^{15}	% of total	1986[2] joules x10^{15}	% of total	1987[2] joules x10^{15}	% of total
Coal	16.55	3.5%	5.97	1.9%	4.77	1.5
Petroleum products						
Residual oil	235.26	49.3	69.97	22.4	69.01	21.6
Distillates	8.71	1.8	4.96	1.6	4.72	1.5
Natural gas	95.70	20.1	80.74	25.9	85.26	26.7
Liquified petroleum gas	0.95	0.2	0.73	0.2	0.78	0.3
Other	4.92	1.0	1.50	0.5	1.65	0.5
Electricity (purchased)	115.09	24.1	148.42[3]	47.5	152.79[4]	47.9
Total	477.18	100.0%	312.29	100.0%	318.98	100.0%

1. Reported on 1972 unit use adjusted to 1987 production.
2. Actual use.
3. 33.75 x 10^{15} joules (10.8%) used in electric boilers.
4. 32.91 x 10^{15} joules (10.3%) used in electric boilers.

Source: Canadian Pulp & Paper Assn.

TRANSPORTATION

Canada's dominant transportation system for shipping forest products is ocean transport, but the country's rail system is heavily indebted to the pulp and paper industry for a large chunk of its income. In 1986, almost 608,000 railcars were loaded with forest products, representing about 17.1% of Canada's total 3.5 million cars and about 35 million metric tons. Forest products represented 17.2% of carloadings in 1985, 16.7% in 1984, 18.8% in 1983, and 17.5% in 1982, according to *Statistics Canada*.

The pulp-and-paper segment of forest-product rail traffic was nearly 217,000 cars (almost 13 million metric tons). This amounted to 6.1% of total rail carloadings, up from 5.9% in 1985 and 5.8% in 1984. It also matches the 6.1% in 1983 and 1981, but it is lower than the 6.2% in 1982. Pulpwood, including roundwood and chips, accounted for more than 184,000 carloadings in 1986, or about 5.2% of the total. This is a slight reversal on the 5.3% in 1985.

Transportation is one of the significant cost elements in the delivered prices of Canadian forest products, according to the Canadian Pulp and Paper Assn. Industry estimates put transportation at about 10% to 13% of the final selling price. Canada is the world's largest exporter of both pulp and paper; approximately 75.9% of the country's pulp and paper production is exported—51% of it to the U.S. in 1986.

"To ship its products from mill to market cost Canada's pulp and paper industry over C$1.4 billion—10% of total sales—in 1985," the CPPA said. Another $600,000 was spent shipping raw materials to the mills. Shipments of pulp and paper are expected to increase 3%/year for the next

CARLOADING OF MAJOR CANADIAN RAILROADS, 1978-86

	1986	1985	1984	1983	1982	1981	1980	1979	1978
(000 cars loaded)									
Pulp & paper	217	213	211	196	191	219	227	231	228
Pulpwood	185	192	189	195	180	205	233	233	230
Other forest products	207	215	211	212	171	205	241	262	289
Total forest products	608	620	611	603	542	629	702	726	747
All rail carloadings	3,546	3,594	3,660	3,210	3,096	3,608	3,796	3,889	3,737
(000 metric tons)									
Pulp & paper	12,934	12,437	12,089	10,954	10,338	11,556	11,888	11,917	11,694
Pulpwood	10,590	10,806	10,574	11,102	9,960	11,157	12,563	12,550	12,233
Other forest products	11,228	11,384	11,048	10,815	8,527	9,713	10,935	11,816	12,864
Total forest products	34,752	34,627	33,710	32,871	28,825	32,425	35,386	36,283	36,791
Total traffic loaded	237,012	237,874	239,866	206,676	199,436	229,690	236,164	237,380	218,783

Source: *Statistics Canada*

four years. From 50% to 55% of the industry's U.S.-bound shipments of pulp and newsprint is by rail

But, unlike its southern neighbor, Canada's rail system relies on two noncompetitive rail systems, and intermodal competition for pulp and paper is much less pervasive than in the U.S. (Canadian National Railway is a Crown corporation and Canadian Pacific [CP] is privately owned.) The U.S. has a number of competing rail lines, plus various intermodal shipping systems using inland waterways and coastal sea routes.

CP moves about 3.0 million tons of pulp and 2.6 million tons of paper a year, or about 86,000 carloads in all, according to Jacques J. Cote, the line's general manager for marketing and sales. A large portion of the shipments are newsprint. In fact, 85% to 90% of the newsprint CP Rail ships from Quebec, the biggest newsprint production area in Canada, ends up in the U.S., Cote wrote in the October 1986 issue of *Journal*, published by the International Forest Products Transportation Assn.

The noncompetitive Canadian rail system changed to a system more like that of the U.S. with implementation of new regulations in January 1988. The new laws include three key areas of interest to pulp and paper producers:

1. **Confidential contracts.** Under the old rules, rates were set publicly. Confidential contracts will allow railways to tailor rates to the specific needs and characteristics of shippers and to adjust rates in a timely and competitive manner. Each shipper will have its own rates, dependent upon a particular cargo and destination and the carrier's largesse.

2. **Competitive line rates.** In the past, mills on captive lines (i.e., where only one of the two railroads served a mill) had to pay for shipment to the cargoes' destination. Under the new guidelines, shippers can ask railways to quote rates to the next interchange of carriers.

3. **Dispute resolution.** The law improves procedures for arbitration of shipper-carrier disputes, improves public-interest appeal procedures, and provides legally mandated refunds when a shipper's position is upheld.

The new law also establishes one-year interim interchange rates. Rates not covered by confidential contracts will still be published. Another important aspect of the new law is the compilation of a database so that results of the legislation can be reviewed in 1992.

Companion truck and ocean carrier bills also were approved in early 1988. The ocean-carrier rules limit the carrier conferences' ability to negotiate and allows for more independent action by individual carriers. Previously, rates were decided by the conferences, which were exempt from Canadian antitrust laws. These carriers haul mostly pulp and newsprint to offshore customers.

ENVIRONMENTAL SPENDING AND REGULATIONS

Canadian pulp and paper mills planned to spend C$240 million on environmental-control projects during the 1987-89 period, or about 4.0% of total announced capital expenditures, according to a January 1988 *Pulp & Paper* survey.

Of the announced environmental spending budget, 48.0% was intended to improve water quality, 43.1% to clean up air pollution, and 8.8% to resolve solid-waste disposal problems. The regional breakdown for Canada's environmental expenditures is as follows:

- **Water quality:** Maritime provinces, 8%; Quebec, 48%; Ontario, 8%; central provinces, 0%; West, 37%.
- **Air quality:** Maritimes, 11%; Quebec, 32%; Ontario, 3%; central provinces, 0%; West, 54%.
- **Solid waste:** Maritimes, 7%; Quebec, 43%; Ontario, 3%; central provinces, 0%; West, 25%.

The differences among provinces reflect partly the priorities of the various provincial governments and partly the priorities and abilities of the paper companies themselves. Over the long run, however, the provinces are roughly equal in their insistence on continued environmental improvement.

Provincial control. A big difference between Canada and the U.S. is that the Canadian provinces have much more authority to regulate pollution compared with the Canadian federal government. Most of the provinces agree to impose regulations that are equivalent to or more stringent than federal regulations. The mills, therefore, usually deal with the provinces on both water and air. Often a province works closely with a mill in implementing control orders.

A recent example of this arrangement was the

ANNOUNCED SPENDING PLANS FOR ENVIRONMENTAL-CONTROL PROJECTS, 1987-89*

(C$000)

Region	Water	Air	Solid waste/ unspecified	Total
Maritimes	C$9,000	C$11,320	C$1,400	C$21,720
Quebec	54,796	32,904	9,105	96,805
Ontario	8,754	3,507	5,360	17,621
Central	—	—	—	—
West	42,670	55,785	5,350	103,805
Total	115,220	103,516	21,215	239,951
% of total pollution-control capital spending	48.0%	43.1%	8.8%	100.0%

* Includes projects for startup in 1989 and after.

Source: *Pulp & Paper* January 1988 Capital Spending Survey.

nine-month negotiation between Kimberly-Clark of Canada Ltd. and Ontario's Ministry of the Environment. K-C had threatened to close its 1,250-metric-tpd bleached kraft pulp mill at Terrace Bay, Ont., which employs about 1,600 people, saying it could not afford to run the mill if it had to install certain pollution-abatement equipment. During the debate, the provincial government reportedly considered a plan to give the company financial aid to help it meet the requirements of any new order. As it stands now, the Ministry has given Terrace Bay until Oct. 31, 1989, to pass fish-kill toxicity tests.

Legal conflicts. Infrequently, provincial law conflicts with federal law. For example, Crown Forest Industries Ltd.'s newsprint and linerboard mill at Campbell River, B.C. (formerly a Crown Zellerbach Canada Ltd. mill), was charged in February 1981 with not complying with the federal Ocean Dumping Control Act (ODCA) permit issued by the federal government. Both the Provincial Court in British Columbia and the Court of Appeal ruled that the ODCA is not valid legislation within British Columbia's coastal waters that are under provincial jurisdiction. The courts held that Section 4(1) of the act is not incidental to federal power to legislate with respect to either navigation or fisheries. The federal Supreme Court was expected to make a final ruling on the case sometime in 1988. In the interim, Environment Canada was administering the ocean dumping program in British Columbia waters under the authority of the Fisheries Act.

WATER POLLUTION

The Fisheries Act of 1970 contains federal water-pollution regulations and guidelines. These regulations establish liquid-effluent requirements for a number of industries. The act makes it an offense to deposit any "deleterious substance" in water frequented by fish. Deleterious substance is defined in terms of alteration or degradation of water quality so as to harm fish and impair the use of fish by people.

The federal government also sets standards for biochemical oxygen demand (BOD) and suspended solids in effluent discharged by existing, expanded, or altered kraft, sulfite, or semichemical pulp mills. Wastes found to be toxic according to a prescribed bioassay test are regulated.

Canada saves time and money in the area of water pollution by using toxicity of effluent as a criterion for discharge. Resin and fatty acids (especially dehydroabietic acid), derived from the wood furnish, and chlorophenolic compounds, derived from pulp bleaching, are the major pulp and paper mill effluents responsible for toxicity. Biotreatment of effluent from kraft and sulfite pulp mills normally reduces these toxins to sublethal levels. It is harder to remove chlorophenols from effluent because of their resistance to biodegradation. According to Environment Canada, manipulation of bleaching cycles or partial substitution of chlorine by chlorine dioxide does not significantly reduce the levels of chlorophenols in final mill effluents.

In a report entitled "Aquatic Toxicity of Pulp & Paper Mill Effluent: A Review," Environment Canada noted the lack of published data on concentrations of potentially toxic compounds in final discharged effluents from mills using mechanical, thermomechanical, chemi-thermomechanical, and other ultrahigh-yield pulping processes. Data are also needed on the effect that high-molecular-weight compounds, such as chlorolignin, have on receiving waters because these compounds could decompose into potentially toxic chlorophenol derivatives. The report also recommended use of rapid bioassay tests in conjunction with the standard LC^{50} bioassay test on rainbow trout. These rapid tests enable mill personnel to assess effluent toxicity due to process changes, inplant spills, and altered treatment systems. They also help monitor residual toxicity of biotreated mill effluents and receiving waters.

The Canadian pulp and paper industry is currently participating with the Ministry of the Environment in a program called Municipal Industrial Strategy for Abatement (MISA). The initial stage of effluent sampling will identify contaminants, which will be analyzed for concentration and ultimately regulated. The sampling and analysis are being done at industry expense, and they will eventually lead to the control of contaminants known to have an impact on human health and the environment. Other industries participating in MISA include chemicals and minerals, electric power generation, iron and steel, mining, and petroleum refining. Municipal sewage treatment plants will also participate.

Dioxin. In late 1987, the Canadian Pulp & Paper Assn. announced that it will investigate how dioxin and other toxins are created during pulping and papermaking "with a view to reducing or eliminating them." To do this, CPPA said it will install equipment at laboratory facilities of the Pulp & Paper Research Institute of Canada at Pointe Claire, Que., that will be capable of testing for low levels of dioxin. The institute will try to develop standard testing procedures to "ensure analytical results will be both accurate and comparable."

CPPA also said it will work with government and private agencies to bring commercial laboratories up to speed so they can test for low levels of dioxin in pulp and paper. The Canadian paper industry is present in nine of Canada's ten provinces, and each provincial government has primary jurisdiction over environmental matters within its boundaries. Therefore, each province will be responsible for implementing some kind of testing program for dioxin.

A spokesman for CPPA said it was unclear whether each province will test the sludge and pulp from every mill in its jurisdiction. It is also unknown whether the mills or the government would pay for the tests. Nevertheless, more commercial labs will have to be equipped before testing on a large scale can occur. Ontario already has a sophisticated testing apparatus in place, and limits on dioxins may be promulgated there first.

In addition, CPPA said it will accelerate research efforts to find alternate systems to chlorine bleaching that are acceptable in terms of cost, pulp quality, and environmental safety. Canada produces more newsprint than any other grade of paper, and groundwood for newsprint is not treated by the chlorine bleaching process. Some observers believe that the only way dioxin can get into newspaper is through wastepaper that has been bleached and eventually used in the furnish. Current testing equipment might not be able to detect dioxin in such low quantities.

In early 1988, Canada's Dept. of Fisheries launched a nationwide study of the effluent discharged by Canada's kraft pulp mills. The tests were ordered because traces of dioxin were found in clams, oysters, crabs, and sole caught near the discharge pipe of the 1,100-metric-tpd bleached kraft pulp mill owned by MacMillan Bloedel Ltd. in Nanaimo, B.C. Dioxin concentrations of up to four parts per trillion (ppt) were found, which is still below the maximum of 20 ppt allowed in fish by the Dept. of Health & Welfare. In addition, the Dept. of Health & Welfare is studying the possible migration of dioxins from paper products to people.

AIR POLLUTION

In recent years, the problem of air pollution in Canada has been inextricably linked with acid rain. In June 1987, the U.S. Supreme Court rejected appeals by eight northeastern states, Ontario, and several environmental groups seeking to force the Reagan administration to abide by a pollution-control commitment made during the Carter administration. These groups contended that a letter written by the administrator of the Environmental Protection Agency in 1981, which said that acid rain was "endangering public welfare in the U.S. and Canada," required future administrations to take steps to reduce acid rain.

The only thing that came out of talks between President Ronald Reagan and Canadian Prime Minister Brian Mulroney in early 1987 was a U.S. agreement to "consider" a bilateral U.S.-Canada accord on combating acid rain. Canada wants a congressionally approved treaty, similar to the one that governs the Great Lakes, with specific timetables and numerical goals for reducing sulfur-dioxide emissions. However, it is unlikely that the U.S. Congress will pass such a treaty. The administration's position is that more research is needed on causes and effects of acid rain before a cleanup program can be implemented. To promote such research, Reagan pledged to spend $2.5 billion in a five-year program to develop technology to fight acid rain.

Tree death in Canada is becoming a grave problem for the nation's forestry industry, especially in the northeastern provinces. A study conducted in Quebec recently reported that the majority of the province's hardwoods are being weakened by pollution. Air pollution also drives away birds, which control the population of insects that feed on trees. For its part, Canada has pledged to reduce its gas emissions by half by 1994. But because Canada claims that about half of its acid rain originates in the U.S., the situation requires the cooperation of its southern neighbor.

The federal government and the provinces also disagree over acid rain. The federal government and the seven provinces east of Saskatchewan committed themselves in February 1985 to cutting acid rain emissions to half their 1980 levels by 1994. Since then, the federal government has tried to hammer out agreements with each of the provinces on their specific contributions to the program. New Brunswick and Nova Scotia were reluctant to honor the agreement. Among other complaints, Nova Scotia Premier John Buchanan said the acid rain in his province comes from Ontario.

TOXIC CHEMICALS

Canada's House of Commons passed the new Environmental Protection Act that would control toxic chemicals. (The Senate was still debating the issue in June 1988, but the act was expected to be passed.) The act also modernizes and clarifies federal environmental legislation, providing for greater consultation among federal departments, between federal and provincial governments, and with the private sector. The scope of the proposed act would be much greater than the existing Environmental Contaminants Act.

Under the new legislation, industry would be required to notify the Minister of the Environment before any chemical is introduced into the country and to submit data describing the chemical's properties so that health- and environmental-impact assessments could be made. Industry would also have to provide information on where and how these chemicals would be used. The act would also require Canadian firms exporting such chemicals to notify an authority in the countries to which the chemical is being shipped. The penalties for noncompliance include fines of up to C$1 million/day and liability of corporate officers for damages.

PAPER GRADES

INTRODUCTION

Five major groupings make up the paper segment of the pulp, paper, and paperboard industry: (1) newsprint, (2) printing papers, (3) fine or writing papers, (4) packaging and converting papers, and (5) tissue papers.

Paper grades therefore are arranged according to their overall end use. But industry convention separates newsprint, the crudest and least expensive publication paper, from the rest of the printing paper sector. This is because newsprint mills produce a simpler product than that made by printing paper mills, and they utilize fewer value-added systems such as coaters or supercalenders.

These general categories can be broken down further by making distinctions about how papers are made and also about the specific end uses for which papers are intended. Such classifications have their own inherent limitations because it is not always easy to separate paper and paperboard grades into their respective groups. For instance, some paper grades such as bristols have basis weights similar to weights of paperboard grades.

The Pulp & Paper North American Factbook relies on

PRINTING/WRITING PAPER SHIPMENTS, 1981-87

(000 short tons)

Grade	1987	1986	1985	1984	1983	1982	1981
Total uncoated free-sheet[1]	11,142	10,504	9,750	9,207	8,765	7,907	7,870
Offset[2]	2,719	2,568	2,377	2,302	2,110	1,981	1,990
Copy/duplicating (BMDX)[3]	2,574	2,428	2,202	2,071	2,220	1,949	1,911
Forms bond[4]	2,284	2,135	1,911	1,805	1,700	1,569	1,569
Envelope	1,169	1,103	1,008	1,003	920	863	854
Tablet	423	404	435	299	400	325	322
Text & cover	289	276	257	265	240	230	239
Other	1,684	1,590	1,560	1,462	1,175	990	985
Total coated paper[1]	7,604	6,260	5,875	6,249	5,695	4,980	4,937
Coated one-side[2]	456	385	369	388	405	395	430
Coated two-sides Nos. 1-4	3,390	2,756	2,514	2,669	2,325	1,930	1,990
Coated two-sides No. 5	3,758	3,118	2,993	3,192	2,965	2,655	2,517
Operating rates							
Uncoated free-sheet	95.3%	94.4%	92.7%	91.5%	94.0%	88.0%	90.0%
Coated groundwood	91.6	91.6	89.0	94.7	95.0	84.0	91.0
Coated free-sheet	95.1	94.5	86.6	93.4	95.0	94.0	94.0

1. American Paper Institute.
2. *Pulp & Paper Week* estimates.
3. Includes bond.
4. Includes carbonless.

U.S. SHIPMENTS[1] OF PAPER GRADES, 1975-86

(000 short tons)

	1986	1985	1984	1983	1982	1981
TOTAL, ALL GRADES	34,702	33,179	32,989	32,205	30,151	29,816
PRINTING, WRITING, AND RELATED PAPERS	25,352	23,861	23,925	22,662	20,986	20,791
Newsprint	5,632	5,503	5,620	5,266	5,063	5,253
Groundwood paper, uncoated	1,574	1,564	1,723	1,604	1,499	1,428
Publication and printing	1,354	1,361	1,488	1,383	1,299	(D)
Supercalendered[2]	(D)	(D)	345	394	248	(D)
Other	1,016	1,004	1,143	989	1,046	1,073
Other converting and miscellaneous	(D)	(D)	(D)	(D)	(D)	200
Body stock for coating	(D)	(D)	(D)	(D)	(D)	(D)
Coated printing and converting paper	6,503	6,036	6,469	5,852	5,224	4,775
Coated groundwood (more than 10% gwd)	3,598	3,384	3,708	3,526	3,115	2,646
Coated one-side	(D)	(D)	(D)	(D)	(D)	77
Coated two-sides	(D)	(D)	(D)	(D)	(D)	2,568
Coated free-sheet (10% gwd or less)	2,905	2,651	2,761	2,326	2,109	2,129
Coated one-side	464	582	580	472	450	455
Coated two-sides	2,441	2,069	2,181	1,853	1,659	1,674
Prime coated stock for coating	—	—	(S)	(S)	(S)	(S)
Uncoated free-sheet (10% gwd or less)	10,242	9,454	8,726	8,572	7,890	7,965
Writing (chemical woodpulp)	5,700	5,299	4,992	4,837	4,451	4,485
Bond and writing, including protective check	2,538	2,316	2,247	2,142	1,946	1,813
Forms bond in rolls	2,040	1,901	1,744	1,663	1,535	1,555
Ledger	69	66	62	62	60	99
Mimeograph (all woodpulp furnishes)	86	76	81	84	80	102
Gelatin and spirit process duplicating	151	158	161	191	164	178
Papeterie and wedding	47	50	55	47	49	61
Body stock for communication, copying	279	237	246	203	174	238
Other technical and reproduction	172	176	156	123	115	141
Tablet	264	264	185	274	269	221
Other (onion skin, manifold, etc.)	53	55	55	49	59	77
Publication and printing	2,755	2,472	2,342	2,193	2,064	2,206
Plain (MF, EF, antique, bulking, SC)	287	266	286	265	217	342
Offset	1,860	1,622	1,551	1,448	1,393	1,443
Other publication and printing	609	584	504	480	454	421
Cover and text papers	410	378	386	372	353	272
Other converting and miscellaneous	1,377	1,305	1,006	1,170	1,022	1,002
Envelope (white woven)	714	666	668	627	575	547
Kraft envelope, bleached and brown	376	354	(D)	350	304	295
Bleached bristols[3]	969	897	940	928	879	904
Tabulating card stock	(D)	(D)	68	107	123	153
Tag and file folder	389	363	356	364	316	311
Tag	212	200	214	215	191	176
Folder	178	164	141	149	125	135
Other uncoated (index, printing, postcard)	290	268	215	240	234	209
Coated	289	266	302	217	205	231
Cotton fiber writing paper and thin paper	432	408	447	440	430	466
Writing, cotton fiber	161	145	144	160	134	113
Bond and writing	125	126	125	131	116	90
Other	36	19	19	29	17	23
Thin paper	270	262	303	280	297	353
Carbonizing free from gwd pulp	(D)	(D)	(D)	(D)	(D)	(D)
Other	(D)	(D)	(D)	(D)	(D)	(D)

continued

U.S. SHIPMENTS[1] OF PAPER GRADES, 1975-80 (continued)

(000 short tons)

	1980	1979	1978	1977	1976	1975
TOTAL, ALL GRADES	30,164	29,580	28,506	28,906	26,534	23,295
PRINTING, WRITING, AND RELATED PAPERS	20,362	19,271	18,482	17,923	16,784	14,656
Newsprint	4,660	3,778	3,489	3,525	3,526	3,476
Groundwood paper, uncoated	1,538	1,800	1,569	1,588	1,460	1,294
Publication and printing	—	—	—	—	1,301	1,169
Supercalendered[2]	156	161	324	334	—	—
Other	1,138	1,420	1,030	1,086	—	—
Other converting and miscellaneous	—	—	215	168	158	125
Body stock for coating	243	220	(D)	(D)	(D)	(D)
Coated printing and converting paper	4,751	4,580	4,513	4,215	4,063	3,318
Coated groundwood (more than 10% gwd)	—	—	—	—	—	—
Coated one-side	123	118	—	—	—	—
Coated two-sides	2,572	2,307	—	—	—	—
Coated free-sheet (10% gwd or less)	—	—	—	—	—	—
Coated one-side	356	364	477	439	—	—
Coated two-sides	—	—	—	—	—	—
Prime coated stock for coating	1,700	1,791	4,036	3,776	(D)	(D)
Uncoated free-sheet (10% gwd or less)	8,008	7,655	7,315	7,036	*	*
Writing (chemical woodpulp)	4,066	3,815	3,589	3,524	3,094	2,683
Bond and writing, including protective check	1,616	1,447	1,415	1,322	1,255	1,065
Forms bond in rolls	1,327	1,330	1,179	1,191	911	892
Ledger	107	117	63	67	64	49
Mimeograph (all woodpulp furnishes)	98	88	103	119	109	100
Gelatin and spirit process duplicating	301	234	196	166	166	147
Papeterie and wedding	48	62	55	48	50	37
Body stock for communication, copying	356	307	169	171	145	111
Other technical and reproduction	122	126	157	153	153	136
Tablet	315	299	219	203	225	215
Other (onion skin, manifold, etc.)	91	109	250	286	231	197
Publication and printing	2,127	2,048	2,199	2,082	1,904	1,561
Plain (MF, EF, antique, bulking, SC)	(D)	(D)	201	147	154	114
Offset	1,930	1,837	1,987	1,921	1,737	1,438
Other publication and printing	(D)	(D)	—	—	—	—
Cover and text papers	263	280	219	196	178	159
Other converting and miscellaneous	(D)	(D)	1,308	1,234	1,070	840
Envelope (white woven)	620	659	609	623	588	474
Kraft envelope, bleached and brown	272	205	212	195	—	—
Bleached bristols[3]	941	957	1,127	1,108	1,041	936
Tabulating card stock	202	217	311	338	354	373
Tag and file folder	285	310	313	280	247	221
Tag	196	199	214	191	163	148
Folder	89	112	99	90	84	73
Other uncoated (index, printing, postcard)	222	188	239	232	228	169
Coated	232	242	264	258	211	173
Cotton fiber writing paper and thin paper	464	502	469	450	**	**
Writing, cotton fiber	131	130	119	111	103	91
Bond and writing	93	91	86	92	76	66
Other	7	7	8	7	5	4
Thin paper	333	371	350	339	345	311
Carbonizing free from gwd pulp	196	238	224	212	198	170
Other[4]	137	134	126	127	148	141

continued

U.S. SHIPMENTS[1] OF PAPER GRADES, 1975-86 (continued)

(000 short tons)

	1986	1985	1984	1983	1982	1981
PACKAGING AND INDUSTRIAL CONVERTING PAPER	4,716	4,697	4,976	5,097	4,873	4,994
Unbleached packaging, industrial converting	2,998	3,065	3,377	3,391	3,308	3,586
Wrapping	57	77	83	90	85	103
Shipping sack	696	755	816	727	787	967
Bag and sack other than shipping sack	1,648	1,712	1,951	1,860	4,154	2,012
Specialty packaging (92 lb and under)	61	109	122	326	251	165
Other converting, including creping (92 lb and under)	536	412	405	388	331	340
Packaging, industrial converting, except unbleached kraft wrapping	1,024	950	901	902	828	923
Wrapping (MG and MF butchers, misc. wrapping)	33	33	50	65	67	80
Shipping sack, including comb. kraft and rope	173	118	113	119	105	118
Unbl. and bl. sulfite, semibl. and bl. kraft; mixtures	162	108	91	95	(D)	84
Other shipping sack paper	11	11	21	24	(D)	34
Other bag and sack	204	240	209	168	143	176
Unbl. and bl. sulfite, semibl. and bl. kraft	142	170	137	121	105	124
Other bag and sack paper	63	70	72	46	38	51
Other converting (19 lb and over)	206	178	186	209	183	163
Waxing stock (18 lb and up)	148	130	132	157	136	120
Other, such as asphalting and creping stock	57	48	51	53	47	42
Specialty packaging	192	168	166	132	124	209
Glassine, greaseproof, and vegetable parchment	216	212	181	209	206	177
Special industrial paper	693	682	697	804	737	485
TISSUE	4,634	4,620	4,089	4,446	4,291	4,031
Sanitary paper	4,503	4,494	3,953	4,337	4,185	3,917
Toilet tissue	1,786	1,833	1,490	1,742	1,679	1,533
Single-ply	1,105	1,198	955	941	962	944
Multi-ply	681	635	534	802	717	588
Facial tissue, excluding toweling, napkin, and toilet	301	302	285	292	277	298
Napkin	595	596	529	594	532	474
Single-ply	431	451	401	467	407	341
Multi-ply	165	144	128	127	125	133
Toweling, excluding wiper stock	1,593	1,521	1,363	1,449	1,433	1,253
Sanitary napkin stock wadding	(D)	(D)	73	99	113	116
Wiper stock, regular, facial, and wadding type	117	111	109	60	56	129
Other sanitary stock	111	131	104	99	94	114
Tissue paper, excluding sanitary and thin	130	126	136	110	106	114
Wrapping tissue	59	56	69	(D)	(D)	(D)
Waxing tissue stock	(D)	(D)	(D)	(D)	(D)	(D)
Creped wadding for interior packaging	(D)	(D)	(D)	(D)	(D)	(D)
Other tissue, excluding sanitary and thin	23	24	31	20	21	25

continued

U.S. SHIPMENTS[1] OF PAPER GRADES, 1975-86 (continued)

(000 short tons)

	1980	1979	1978	1977	1976	1975
PACKAGING AND INDUSTRIAL CONVERTING PAPER	5,327	5,708	5,778	5,931	5,727	4,824
Unbleached packaging, industrial converting	3,718	3,911	3,872	4,061	3,917	3,399
Wrapping	137	187	210	218	201	165
Shipping sack	1,062	1,110	1,019	1,073	1,102	879
Bag and sack other than shipping sack	2,101	2,115	2,092	2,212	2,125	1,938
Specialty packaging (92 lb and under)[5]	2,074	2,085	2,064	2,182	2,076	1,892
Other converting, incl. creping (92 lb and under)[6]	419	499	551	558	488	417
Packaging, industrial converting, except unbleached kraft wrapping	1,145	1,266	1,408	1,346	1,224	985
Wrapping (MG and MF butchers, misc. wrapping)	103	119	155	136	134	115
Shipping sack, including comb. kraft and rope	92	102	92	107	120	95
Unbl. and bl. sulfite, semibl. and bl. kraft; mixtures	(D)	(D)	(D)	(D)	—	—
Other shipping sack paper	(D)	(D)	(D)	(D)	97	69
Other bag and sack	229	250	273	304	261	228
Unbl. and bl. sulfite, semibl. and bl. kraft	155	170	217	198	140	133
Other bag and sack paper	73	80	55	106	121	94
Other converting (19 lb and over)	251	287	264	236	407	335
Waxing stock (18 lb and up)	98	113	76	69	109	97
Other, such as asphalting and creping stock	52	59	—	—	115	94
Specialty packaging	269	273	365	344	—	—
Glassine, greaseproof, and vegetable parchment	202	234	259	219	202	191
Special industrial paper	464	531	498	524	586	440
TISSUE	4,474	4,601	4,246	4,243	4,123	3,846
Sanitary paper	4,298	4,403	4,036	4,045	3,930	3,669
Toilet tissue	1,706	1,772	1,629	1,605	1,566	1,422
Single-ply	939	978	939	877	916	328
Multi-ply	766	794	690	729	650	594
Facial tissue, excluding toweling, napkin, and toilet	370	376	383	365	359	374
Napkin	532	533	429	470	448	436
Single-ply	409	404	317	353	342	334
Multi-ply	123	129	112	117	106	102
Toweling, excluding wiper stock	1,439	1,482	1,375	1,388	1,326	1,230
Sanitary napkin stock wadding	103	98	87	73	73	55
Wiper stock, regular, facial, and wadding type	74	63	57	48	67	62
Other sanitary stock	74	78	76	96	91	89
Tissue paper, excluding sanitary and thin	176	198	210	197	193	178
Wrapping tissue	72	63	75	74	61	47
Waxing tissue stock	24	31	32	28	37	39
Creped wadding for interior packaging	25	41	37	35	30	34
Other tissue, excluding sanitary and thin	18	21	29	28	30	22

Note: Categories shown are those now used by Bureau of the Census. Categories in older reports do not always correspond to the present ones.

(D) Data withheld to avoid disclosing figures for individual companies.

(S) Suppressed because the data did not meet publication standards of the Bureau of the Census.

* "Book paper, uncoated, total." 1976, 2,973,891 tons; 1975, 2,401,131; 1974, 2,831,562.

** "Writing and related papers, not included elsewhere, total." 1976, 3,720,678 tons; 1975, 3,244,141; 1974, 4,101,606.

1. Reported as production by Bureau of the Census prior to 1981.
2. Forms bond included 1984 and 1985 only.
3. Excluding cotton fiber index and bogus.
4. Cigarette, condenser, other.
5. Grocery bag and sack paper.
6. Other unbleached kraft bag paper.

Source: Bureau of the Census.

classifications established by the U.S. Bureau of the Census and those used by the American Paper Institute (API) and the Canadian Pulp & Paper Assn. (CPPA). For example, these classifications distinguish uncoated free-sheet—the source of most fine papers and also of a large volume of printing papers for certain uses—from coated paper, used almost exclusively for publishing and commercial printing. They also draw a line between coated publication papers and uncoated groundwood paper. Both are used widely for magazines, catalogs, and newspaper inserts, but they represent opposite ends of the publication-paper price spectrum and are thus intended for completely different types of publications.

It is also important from the papermaker's point of view to distinguish, for example, between free-sheet papers (made with little or no mechanical pulp) and groundwood papers (commonly made with stone groundwood or thermomechanical pulp), or between the wood-fiber papers that make up better than 95% of all paper and the cotton-fiber papers that make up a small but stable sector of the fine-paper group.

Factbook approaches the paper side of the industry by looking at the eight major subgroupings that are commonly understood and accepted:

- Newsprint
- Uncoated groundwood papers
- Coated papers
- Uncoated free-sheet papers
- Cotton-fiber papers
- Bristols
- Packaging and industrial converting papers
- Tissue

Each chapter examines detailed production and market distinctions within these categories, and examines any important trends in production technique or end use.

Some generalizations apply to the entire paper sector. Paper grades are generally produced on fourdrinier paper machines or twin-wire formers, but in a few cases cylinder board machines or multi-ply formers are used. Paper machines exist in many sizes and configurations according

U.S. PRODUCTION AND CAPACITY FOR PAPER GRADES

(000 short tons)

	Production[1]		Capacity[2]		
	Tonnage	% change	Tonnage	% change	Utilization rate (%)
1990p	—	—	42,687	3.0%	—
1989p	—	—	41,437	2.9	—
1988p	—	—	40,278	2.4	—
1987p	—	—	39,336	3.5	—
1986	34,702	4.6%	38,014	1.2	93.3%
1985	33,179	3.7	37,581	1.3	90.6
1984	32,989	9.4	37,106	4.0	92.8
1983	30,151	–0.9	35,675	2.8	92.4
1982	30,422	2.0	34,696	2.9	87.7
1981	29,816	–1.5	33,706	3.2	92.1
1980	30,281	2.4	32,659	4.7	92.7
1979	29,580	4.7	31,179	2.4	96.3
1978	28,253	0.6	30,460	2.1	93.6
1977	28,096	5.5	29,831	2.1	94.1
1976	26,612	14.1	29,210	0.9	91.1
1975	23,306	–12.6	28,922	1.3	80.5
1974	26,651	0.7	28,532	3.2	93.4
1973	26,483	4.1	27,621	1.7	95.3
1972	25,435	6.8	27,156	3.3	93.6
1971	23,811	0.7	26,270	1.7	90.6
1970	23,625	0.1	25,806	2.1	91.5
1969	23,596	—	25,257	—	93.4
Average 1977-86		3.1%		2.7%	

e = *Pulp & Paper* estimate.

[1] Bureau of the Census data. Includes newsprint, printing/writing, packaging and industrial papers, and tissue.

[2] American Paper Institute.

CANADIAN PRODUCTION AND CAPACITY FOR PAPER GRADES

(000 short tons)

	Production[1]		Capacity[1]	
	Tonnage	% change	Tonnage	% change
1988p	—	—	15,665	2.5%
1987	14,717	5.4%	15,280	2.4
1986	13,962	5.0	14,921	3.2
1985	13,298	2.6	14,458	1.3
1984	12,965	3.4	14,270	0.9
1983	12,536	6.5	14,149	1.9
1982	11,772	–6.9	14,012	3.8
1981	12,640	3.6	13,502	4.0
1980	12,200	–0.5	12,975	0.9
1979	12,259	0.9	12,855	2.0
1978	12,148	9.0	12,603	0.9
1977	11,146	3.6	12,493	0.8
1976	10,757	17.1	12,396	1.0
1975	9,186	–22.0	12,275	0.9
1974	11,782	6.0	12,168	–1.0
1973	11,120	3.9	12,292	1.4
1972	10,700	4.7	12,121	—
1971	10,215	–1.4	—	—
1970	10,357	–0.1	—	—
1969	10,372	—	—	—

[1] Excludes building papers.

p = Projected.

Source: Canadian Pulp & Paper Assn.

to the single grade of paper to be produced, or according to a papermaker's particular requirements for his own product.

The process seems very simple: a slurry of fibers and water is drained (dewatered) on a wire, after which further excess water is removed by pressing and drying. The dried sheet is then wound on a reel from which rolls or sheets of paper are produced.

But in reality, papermaking is a complex process, combining sophisticated and evolving technology—and decades of experience.

The intent of this report is not to discuss papermaking in detail; numerous technical reference books exist for this purpose. The main purpose of this work is to provide the reader with an overall introduction to the most important sectors of the paper industry, with discussions elsewhere in the book of important themes for the entire pulp, paper, and paperboard industry.

While reading chapters on particular grades of paper, however, the reader should keep in mind that no two mills make the same grade of paper by exactly the same method or with the same equipment.

One mill may make newsprint on a twin-wire former using 100% wastepaper, while other mills may produce a similar quality of newsprint with a fourdrinier machine and groundwood pulp. Some paper mills are modern, using the most up-to-date, large-scale equipment available, whereas other paper mills make similar grades on small equipment at 100-year-old sites—mills still in operation because they serve a particular market need, and because using entirely paid-for equipment permits them to do so economically.

ESTIMATED NUMBER OF MACHINES AND TOTAL CAPACITY IN U.S.—1975 AND 1986

	Machines in 1986		Machines in 1975	
	Number	Annual tpy (000 tons)	Number	Annual tpy (000 tons)
Total paper	858	38,014	981	28,922
Newprint	42	5,804	38	3,848
Printing, writing & related	426	20,980	475	14,274
Packaging & ind. converting	178	5,758	228	6,368
Tissue	212	5,472	240	4,432

Source: American Paper Institute capacity surveys.

PUBLICATION PRINTING TECHNOLOGY PROCESSES CHANGES: 1985 TO 1987*

	1987	1986	1985
Offset	73.3%	73.0%	73.7%
Gravure	26.7	27.0	26.3

* Percentage of use by magazine publishers.

Source: Magazine Publishers Association, "The Paper Outlook."

CANADIAN PAPER PRODUCTION

(000 short tons)

	Newsprint	Groundwood printing/ specialty	Other book and writing	Wrapping papers	Tissue/ specialty	Building papers	Total
1987	10,661	1,498	1,430	625	503	—	14,717
1986	10,238	1,346	1,300	596	506	142	14,127
1985	9,907	1,157	1,205	537	493	138	13,437
1984	9,935	1,054	1,122	514	198	134	12,959
1983	9,354	1,046	1,168	535	433	155	12,691
1982	8,947	715	916	499	413	137	11,627
1981	9,866	883	880	577	434	130	12,770
1980	9,507	677	987	613	416	140	12,340
1979	9,551	624	1,008	668	408	138	12,397
1978	9,670	580	871	637	390	142	12,290
1977	8,988	463	759	571	365	155	11,301
1976	8,915	384	544	580	335	165	10,923
1975	7,679	311	437	475	283	161	9,346
1970	8,719	289	616	493	240	101	10,458
1969	8,818	214	544	514	281	116	10,487

e = Estimate.

Source: Canadian Pulp & Paper Assn., *Pulp & Paper.*

VALUE OF SHIPMENTS OF PRIMARY PAPER PRODUCTS

($000)

	1986	1985	1984	1983	1982	1981	1979	1977	1975
TOTALS[1]	$25,267	$24,194	$24,272	$21,399	$19,417	$19,607	$15,784	$12,438	$9,370
Newsprint	2,470	2,393	2,344	2,122	2,138	2,187	1,226	989	828
Uncoated groundwood	911	908	1,043	870	733	765	723	539	403
Publication/printing	790	832	901	—	—	—	—	—	—
Coated printing & converting	5,450	5,426	5,365	4,255	3,799	3,446	2,825	2,261	1,473
Coated groundwood	2,600	2,791	2,729	2,229	2,000	—	—	—	—
Coated free-sheet	2,850	2,635	2,636	2,026	1,799	—	—	—	—
Uncoated printing/writing[2]	7,372	6,704	6,959	5,985	5,463	5,660	4,666	3,353	2,845
Writing, chemical pulp	4,061	3,741	3,889	3,392	3,107	3,221	—	—	—
Publication/printing	1,963	1,687	1,784	1,516	1,414	1,521	—	—	—
Cover/text	510	468	466	362	320	277	—	—	—
Other	838	807	820	715	621	641	—	—	—
Cotton fiber and thin	688	688	732	633	666	696	645	496	—
Bleached bristols	693	647	692	640	563	585	502	474	355
Unbleached kraft packaging[3]	1,149	1,090	1,331	1,190	1,151	1,343	1,244	1,099	873
Packaging and converting[4]	819	778	795	717	797	758	760	561	439
Special industrial	939	968	992	1,011	631	617	575	551	389
Tissue	4,777	4,593	4,019	3,977	3,679	3,550	2,618	2,116	1,765

1. Totals are higher than individual values due to inclusion of nonclassified grades.
2. Uncoated free-sheets.
3. Plus industrial converting papers.
4. Except unbleached kraft.

Source: Bureau of the Census.

MARKET INDICATORS FOR PAPER GRADES: ESTIMATED ANNUAL U.S. ADVERTISING EXPENDITURES

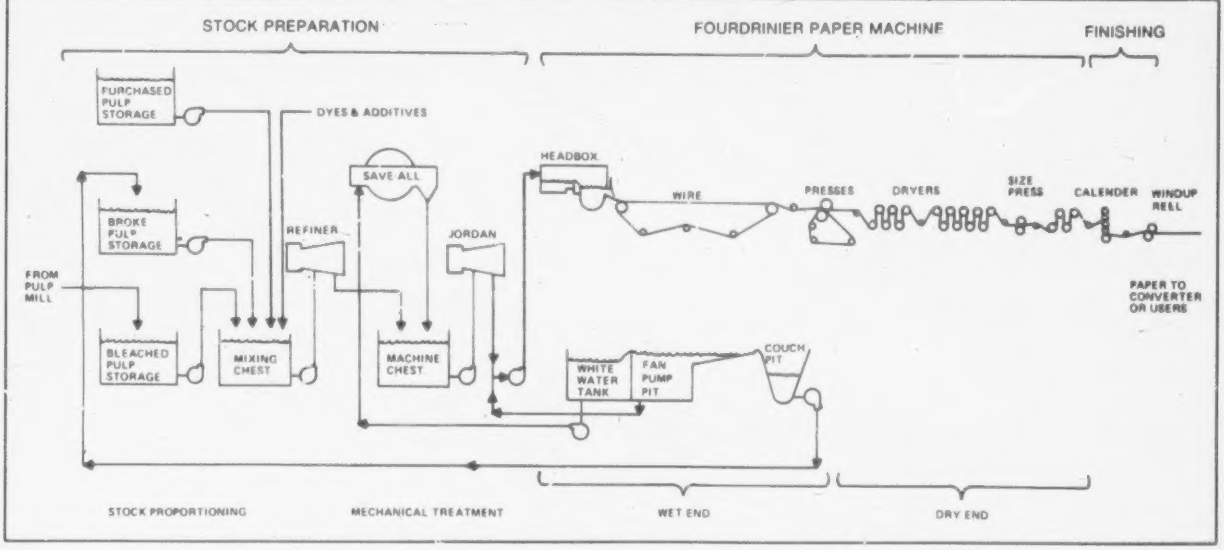
($ million)

	Newspapers	Magazines	Television	Radio	Direct mail	Total expenditures[1]
1988e	—	—	—	—	—	$119,000
1987e	—	—	—	—	—	110,000
1986	$26,990	$5,317	$22,585	$6,949	$17,145	102,000
1985	25,170	5,155	20,770	6,490	15,500	95,000
1984	23,715	4,850	18,585	6,025	13,480	—
1983	20,582	4,233	16,136	5,210	11,795	—
1982	17,694	3,710	14,329	4,670	10,319	—
1981	16,528	3,533	12,650	4,230	8,944	—
1980	14,794	3,149	11,366	3,702	7,596	54,000
1979	13,863	2,932	10,154	3,310	6,653	—
1978	12,214	2,597	8,955	3,052	5,987	—
1977	10,751	2,162	7,612	2,634	5,164	—
1976	9,618	1,789	6,721	2,330	4,786	—
1975	8,234	1,465	5,263	1,980	4,124	28,000
1970	5,704	1,292	3,596	1,308	2,766	20,000
1965	4,426	1,161	2,515	917	2,324	15,000

e = Estimate.
1. Includes other expenditures.

Source: Prepared for *Advertising Age* by Robert J. Coen, McCann-Erickson Inc.

TYPICAL FLOW DIAGRAM FOR A FINE PAPER MILL


STOCK PREPARATION
FOURDRINIER PAPER MACHINE
FINISHING
PURCHASED PULP STORAGE
DYES & ADDITIVES
SAVE-ALL
HEADBOX
BROKE PULP STORAGE
REFINER
JORDAN
WIRE
PRESSES
DRYERS
SIZE PRESS
CALENDER
WINDUP REEL
FROM PULP MILL
PAPER TO CONVERTER OR USERS
BLEACHED PULP STORAGE
MIXING CHEST
MACHINE CHEST
WHITE WATER TANK
FAN PUMP PIT
COUCH PIT
STOCK PROPORTIONING
MECHANICAL TREATMENT
WET END
DRY END

MARKET INDICATORS, PRINTING AND PUBLISHING PAPERS: VALUE OF SHIPMENTS

($ million current)[1,2]

SIC code:	Newspapers 2711	Periodicals 2721	Book publishing 2731	Book printing 2732	Commercial printing 2751, 2752, 2754	Manifold business forms 2761
1987e	$31,602	$17,075	$11,675	$3,375	$41,619	$7,754
1986e	29,091	16,164	10,810	3,125	38,727	7,152
1985	27,015	15,246	10,196	2,919	35,559	6,669
1984	25,302	14,053	9,459	2,828	33,114	6,297
1983	24,050	12,943	8,475	2,600	28,785	5,195
1982	21,286	11,525	7,723	2,392	27,091	5,034
1981	20,050	9,843	6,760	2,556	23,149	4,735
1980	17,750	9,229	6,675	2,325	19,700	4,308
1979	16,125	8,240	6,040	2,100	18,200	3,846
1978	14,500	7,292	5,495	1,920	16,500	3,259
1977	12,966	6,077	4,882	1,696	14,800	2,884
1976	11,659	5,044	3,968	1,328	13,355	2,328
1975	10,433	4,380	3,537	1,241	11,691	2,185
1970	6,967	3,096	2,434	800e	7,865	1,233

e = Estimate.

1. Value for industry, including service.

2. Other printing categories, such as engraving and plate printing, greeting card publishing, blankbooks and looseleaf binders, bookbinding work, typesetting, photoengraving, electrotyping, and platemaking services are not included but amounted to $7.2 billion in 1984.

NEWSPRINT

GRADE STRUCTURE

Newsprint is used primarily by newspapers, with much of the remainder going to commercial printers for preprinted newspaper inserts and government printing jobs. The furnish is mostly mechanical pulp, with chemical pulp added to improve runability on the paper machine and the printing press.

Most newsprint is now produced on twin-wire units, replacing the traditional fourdrinier. An estimated 56% of North American newsprint capacity in 1986 was equipped with twin-wires. These are either new machines or existing fourdriniers that have been rebuilt with twin-wires (such as the Bel Baie, Sym-Former, or Verti-Forma). One way to modify a fourdrinier is through the addition of a top-wire former, which can be installed in as little as two days.

STATISTICS FOR NEWSPRINT

	1988e	1987	1986
UNITED STATES			
Production, 000 short tons	5,960	5,842	5,630
Capacity, 000 tons	6,013	5,941	5,804
Utilization rate, %	99.1	98.3	97.0
Apparent U.S. consumption			
000 tons	14,890	14,547	13,825
lb/capita	121.4	119.7	114.8
000 tons/$ billion real GNP	3.79	3.78	3.70
CANADA			
Production, 000 short tons	10,876	10,663	10,238
Capacity, 000 tons	11,199	11,051	10,896
Utilization rate, %	97.1	96.5	94.0

e = Estimate.

Source: *Pulp & Paper.*

Newsprint produced on twin-wire machines has better sheet characteristics and less two-sidedness, and twin-wires can add marginally to speeds on paper machines that are drainage limited. Speedup results from faster drainage. In the early 1980s, the startup of *USA Today*, a Gannett daily national newspaper, fostered the use of twin-wire newsprint, which enables publishers to make better use of four-color printing.

Newsprint in the U.S. usually comes in a standard basis weight of 30 lb/3,000 ft^2, or 48.8 g/m^2. However, Champion International Corp.'s Texas mills make newsprint at 28.5 lb (46.4 g/m^2), and Great Northern Nekoosa Corp.'s standard is 28 lb. Paper is available in standard basis weights as high as 35 lb (56.9 g/m^2). Prior to 1974, the standard basis weight was 32 lb (52.1 g/m^2), but it was reduced to trim costs and conserve fiber.

Because three major printing methods are used by consumers of newsprint, paper manufacturers vary sheet surface qualities, including basis weight, opacity, and brightness.

Letterpress is still the most widely used printing method in the U.S., although offset printing has been gaining in popularity. In 1970, letterpress accounted for virtually all newspaper printing, but it declined to 70% by 1980. This drop is expected to continue, sliding to 55% by 1990. For longer press runs of over one million copies, rotogravure remains the preferred method. Newsprint for rotogravure costs about 10% more than the other two grades of newsprint.

Most newsprint is not sized, apart from the addition of alum at the grinders to prevent resin buildup. Fillers are generally needed, due to the high opacity of groundwood pulp. Bleaching is done with peroxides or hydrosulfites, giving a final brightness of about 55 or 60 in contrast to the 60 to 65 brightness range preferred for higher grades of uncoated groundwood paper, such as directory.

Although the furnish used for newsprint is still primarily groundwood, thermomechanical (TMP) and chemi-thermomechanical (CTMP) pulps are becoming more common. In many mills, TMP is used to replace some chemical pulp, which supplies 10% to 15% of newsprint furnish. With its longer fibers, chemical pulp makes a stronger sheet. Unbleached softwood sulfite pulps are used more commonly in Canada than in the U.S., where semibleached sulfate softwood pulp is preferred. TMP is weaker than chemical pulp but stronger than groundwood, and it costs less than chemical pulp.

Secondary fiber also is used in some newsprint furnishes. Waste newspapers are deinked and added to other types of pulp or used entirely. Garden State Paper Co. operates two mills making newsprint from 100% deinked old newspapers, which are plentiful in the areas where the mills are located. Other mills which use deinked newsprint combine it with mechanical pulp or TMP. The mix varies widely according to fiber availability and the mill's specific cost structure.

Recently, extensive studies have been done on newsprint made from kenaf—a fast-growing, nonwood fibrous plant—by the American Newspaper Publishers Assn. (ANPA), and the efforts have been taken up by Kenaf International. This company includes the *Bakersfield Californian*, Agrifutures Inc., and Charles S. Taylor, a former ANPA project manager. In the summer of 1987,

NORTH AMERICAN CAPACITY BY REGION

(000 metric tons)

UNITED STATES

Year	Northwest/ Midwest	South	West	Total
1989p	688	3,057	1,715	5,460
1988p	684	3,047	1,714	5,445
1987p	662	3,034	1,714	5,410
1986	654	2,992	1,714	5,360
1985	653	2,972	1,700	5,325
1984	604	3,103	1,688	5,305
1983	576	2,978	1,681	5,235
1982	584	2,940	1,606	5,130
1981	592	2,918	1,440	4,950
1980	633	2,627	1,160	4,420
1979	609	2,205	996	3,810
1978	670	2,080	960	3,710

CANADA

Year	Quebec	Ont./ Man.	B.C.	Atlantic	Total
1990p	4,735	2,175	1,520	1,770	10,200
1989p	4,695	2,150	1,545	1,770	10,160
1988p	4,660	2,125	1,610	1,765	10,160
1987p	4,585	2,075	1,625	1,740	10,025
1986p	4,475	2,060	1,595	1,755	9,885
1985	4,500	2,040	1,630	1,650	9,820
1984	4,415	2,090	1,710	1,605	9,820
1983	4,535	2,045	1,770	1,620	9,970
1982	4,580	1,980	1,710	1,665	9,935
1981	4,495	1,985	1,440	1,570	9,490
1980	4,308	1,985	1,352	1,485	9,130
1979	4,251	1,972	1,395	1,445	9,063
1978	4,263	1,920	1,370	1,429	8,982

p = Preliminary.

Source: Canadian Pulp & Paper Assn., *Newsprint Data.*

U.S. NEWSPRINT CAPACITY AND PRODUCTION

(000 short tons)

Year	Capacity	Production	Operating rate
30-lb weight			
1990p	6,636	—	—
1989p	6,099	—	—
1988p	6,013	—	—
1987p	5,941	5,842	98%
1986	5,804	5,630	96
1985	5,788	5,428	94
1984	5,851	5,539	95
1983	5,774	5,167	87
1982	5,654	5,042	86
1981	5,457	5,239	94
1980	4,836	4,672	94
1979	4,199	4,062	95
1978	4,104	3,768	92
1977	4,069	3,871	95
1976	4,014	3,7[illegible]6	94
1975	3,848	3,691	92
1974	3,722	3,561	93
32-lb weight			
1974*	3,889	3,690	93
1973	3,819	3,738	96
1972	3,694	3,656	98
1971	3,642	3,476	95
1970	3,533	3,464	98
1969	3,374	3,362	100
1968	3,176	3,045	96
1967	2,844	2,709	95
1966	2,545	2,483	98
1965	2,372	2,245	95

p = Preliminary.
* Adjusted to 32-lb equivalent basis weight.

Sources: Canadian Pulp & Paper Assn. and American Paper Institute.

U.S. CONSUMPTION OF NEWSPRINT

(000 short tons)

Year	Consumption	Shipments from U.S.	Shipments from Canada	Shipments from Others	Consumer stocks[1]
30-lb weight					
1987	13,613	5,540	7,812	387	1,523
1986	13,171	5,266	7,424	331	1,399
1985	12,772	5,123	7,357	365	1,537
1984	12,600	5,299	7,260	208	1,465
1983	11,672	4,860	6,651	74	1,300
1982	11,142	4,686	6,168	46	1,387
1981	11,204	4,907	6,682	41	1,628
1980	11,120	4,473	6,744	138	1,202
1979	11,240	3,970	7,023	146	967
1978	10,872	3,674	7,102	0	1,070
1977	10,232	3,737	6,341	0	1,181
1976	9,611	3,632	6,251	57	1,333
1975	9,254	3,566	5,489	33	1,004
1974	10,284	3,457	6,949	213	1,170
32-lb weight					
1974*	10,685	3,582	7,239	213	1,248
1973	10,794	3,657	6,855	381	782
1972	10,547	3,549	6,430	328	784
1971	9,835	3,307	6,146	317	1,041
1970	9,706	3,316	6,163	314	1,110
1969	9,855	3,246	6,431	293	1,017
1968	9,327	2,944	6,107	284	894
1967	9,238	2,612	6,263	283	885

1. Based on data from American Newspaper Publishers Assn.
* Adjusted to 32-lb equivalent basis weight.

Source: Canadian Pulp & Paper Assn.

NEW NORTH AMERICAN NEWSPRINT MACHINES IN 1980s

Company	Location	Capacity (short tons)	Startup
Bear Island Paper	Ashland, Va.	175	1980
Boise Southern	DeRidder, La.	192	1980
MacMillan Bloedel	Powell River, B.C.	176	1981
Publishers Paper	Newberg, Ore.	210	1981
North Pacific Paper	Longview, Wash.	210	1981
B.C. Forest Products	Crofton, B.C.	193	1982
Crown Forest Industries	Campbell River, B.C.	193	1982
Donohue-Normick	Amos, Que.	175	1982
Quebec & Ontario Paper	Thorold, Ont.	171	1982
Quebec & Ontario Paper	Thorold, Ont.	171	1982
Abitibi-Price	Iroquois Falls, Ont.	209	1983
Abitibi/Augusta News	Augusta, Ga.	226	1983
CIP	Gatineau, Que.	155[1]	1987
Donohue	Clermont, Que.	140[2]	1987

1. Metric tons.
2. Metric tons, net increase.

Source: *Pulp & Paper Project Report.*

CIP Inc. produced about 85 short tons of newsprint from kenaf pulp at its Trois Rivières, Que., mill. Several southwestern newspapers used the 70 tons of newsprint output and reported that it was stronger and whiter, requiring less ink and yielding brighter colors. Containing no lignin, the paper will not yellow. Lower production costs and less pollution are cited as other advantages.

INDUSTRY STRUCTURE

Canada and the U.S. together produce approximately half the world's supply of newsprint. Canada produces more than 30% of the world's consumption, while the U.S. produces in excess of 17%. No other nation produces more than 10%. The U.S. is the world's leading consumer of newsprint, using an estimated 40% or more of global supplies. The nearest rival is Japan, consuming an estimated 9% to 10%.

Canada is the world's leading producer of newsprint, and it consumes 10% to 12% of its own production. Canada is also the world's top exporter of newsprint, accounting for over 60% of global exports. Canada's leading customer is the U.S., which accounted for 82% of 1987 Canadian exports, representing about 57% of U.S. consumption.

The U.S. newsprint industry has expanded, so it supplied 43% of domestic consumption in 1987 compared with 34% in 1978. At the same time, Canadian exports to the U.S. have dropped to 57% from 66% in 1978. U.S. newsprint imports from countries other than Canada advanced rapidly to 350,900 metric tons in 1987 from 67,000 tons in 1983.

Canada has the bulk of North American newsprint capacity, producing about 65% of the 14.9 million metric

CANADIAN CAPACITY, PRODUCTION, AND SHIPMENTS OF NEWSPRINT

(000 short tons)

Year	Capacity[1]	Production	Operating rate	Change in capacity	Change in production	Shipments
30-lb weight						
1989e	11,199	—	—	0	—	—
1988e	11,199	—	—	148	—	—
1987	11,051	10,663	97%	155	425	10,755
1986	10,896	10,238	94	71	331	10,254
1985	10,825	9,907	92	0	–28	9,916
1984	10,825	9,935	92	–167	581	9,941
1983	10,990	9,354	85	39	415	9,302
1982	10,951	8,947	82	540	–922	8,899
1981	10,411	9,861	94	347	354	9,829
1980	10,064	9,507	94	77	–144	9,504
1979	9,987	9,651	97	126	–62	9,677
1978	9,861	9,713	98	–41	725	9,792
1977	9,902	8,988	91	–19	73	9,005
1976	9,921	8,915	90	29	1,236	8,712
1975	9,892	7,697	78	–146	–1,869	7,728
1974	10,038	9,548	95	—	—	9,597
32-lb weight						
1974[2]	10,474	9,946	95%	137	806	9,998
1973	10,337	9,140	88	37	320	9,199
1972	10,300	8,820	86	60	365	8,901
1971	10,240	8,455	83	395	–264	8,362
1970	9,845	8,719	89	170	–99	8,704
1969	9,675	8,818	91	20	787	8,797
1968	9,655	8,031	83	361	–20	8,096
1967	9,294	8,051	87	416	–368	7,968
1966	8,878	8,419	95	457	699	8,385
1965	8,421	7,720	92	147	419	7,747

e = Estimate.

1. Tonnage data for 1965-74 are based on 32-lb weight newsprint; those for 1974-77 are measured in terms of 30-lb basis weight.

2. Adjusted to 32-lb equivalent basis weight.

Source: Canadian Pulp & Paper Assn.

tons of newsprint manufactured in the U.S. and Canada in 1987. However, the U.S. has experienced the greatest growth in capacity during the past decade. Between 1976 and 1986, U.S. capacity went up 46%, while Canadian capacity rose by only 11.5%.

Capacity increases in both countries have slowed considerably since the early 1980s. With the glut of newsprint hanging over the marketplace in recent years, major expansions have been kept to a minimum while older machines have been shut down. In addition, more groundwood capacity has been geared to groundwood specialties rather than to newsprint production.

Canadian newsprint capacity is expected to go up 2.8% (303,000 metric tons) between 1986-89, while U.S. capacity is expected to rise 5.1% (295,000 tons), according to the Canadian Pulp & Paper Assn. and American Paper Institute surveys. This would bring Canadian newsprint capacity to 10.2 million tons and U.S. capacity to 5.5 million tons by 1989. Major Canadian projects included in the surveys are new machines at Donohue Inc.'s Clermont, Que., and CIP's Gatineau, Que., newsprint mills, which were scheduled to start up in 1987.

However, a number of additional projects have been announced since those surveys, thanks to tightening supply and rising prices. In the U.S., Newsprint South Inc. (a subsidiary of Mississippi Chemical cooperative), Southeast Newsprint, Finlay Forest Industries Ltd., Ponderay Newsprint Co. (Great Lakes Forest Products Ltd. and five publishers), Howe Sound Pulp & Paper Co. Ltd. (a partnership of Canfor Corp. and Oji Paper Co. Ltd.), and Gold River Newsprint Ltd. Partnership (a new company formed by CIP and five investors) plan to install new machines over the next several years.

When all these new machines come on line by 1991, they will add more than one million tons to the CPPA's estimated projection of 15.6 million metric tons of total 1989 North American capacity. In addition, newsprint machines are under study by Bear Island Paper Co., Ashland, Va.; Donohue Normick Inc., Amos, Que.; Normick/Forex, Val d'Or, Que.; Westbrook Wood Products,

NORTH AMERICAN NEWSPRINT CAPACITY EXPANSIONS, 1987-91

Company	Mill	Capacity (000 metric tpy)	Startup
Announced			
CIP	Gatineau, Que.	60 (net)*[1]	1987
Great Northern	E. Millinocket, Maine	93 (net)[2]	1987
Consolidated-Bathurst	Ville de la Baie, Que.	72	1987
Donohue	Clermont, Que.	140 (net)*[3]	1987
Quebec & Ontario	Baie Comeau, Que.	17	1987
Kruger	Corner Brook, Nfld.	90[4]	1987
		162[4]	1988
Stora	Port Hawkesbury, N.S.	20	1987
Maclaren	Masson, Que.	30	1988
Quebec & Ontario	Thorold, Ont.	15	1988
Cascades	Niagara Falls, N.Y.	35[5]	1988
MacMillan Bloedel	Powell River, B.C.	65[6]	1988
Crown Forest	Elk Falls, B.C.	50	1988
Catawba Newsprint	Catawba, S.C.	10	1988
British Columbia Forest Products	Crofton, B.C.	35	1988
Abitibi-Price	Alma, Que.	(60)[7]	1988
Soucy	Rivière du Loup, Que.	15[8]	1988
Bowater Mersey	Brooklyn, N.S.	50	1989
North Pacific	Longview, Wash.	20	1989
Finlay Forest	Mackenzie, B.C.	216*	1989
Gold River[10]	Gold River, B.C.	225*	1989
Newsprint South	Grenada, Miss.	205*	1989
Southeast Newsprint	Dublin, Ga.	190*[9]	1990
Ponderay Newsprint[11]	Usk, Wash.	180*	1990
Gaspesia[12]	Chandler, Que.	25	1990
Abitibi-Price/ Parsons & Whittemore	Claiborne, Ala.	220*	1990
Atlantic Packaging	Whitby, Ont.	150*[3]	1990
Alberta Newsprint[13]	Whitecourt, Alta.	220*	1990
Great Lakes Forest Products	Thunder Bay, Ont.	60 (net)[14]	1991
Howe Sound[15]	Port Mellon, B.C.	200*	1991

continued

Medford, Ore.; Smurfit Newsprint Corp., Newberg, Ore.; and Alberta Newsprint Co. Ltd. headed by Vancouver, B.C., businessman Ronald Stern, Whitecourt, Alta.

Observers once thought that because of the high cost of new mills, along with dwindling reserves of untapped forestland, future Canadian capacity expansion would be concentrated in incremental expansions and additional machines at existing mills. This appears to be changing, as newsprint supplies in the late 1980s led to a seller's market. However, if many more announcements are made for new machines in the early 1990s, the newsprint industry is likely to slip into another overcapacity situation by the beginning of the next decade.

Upgrading capacity. The machine makeup in the newsprint industry has gradually changed since 1981. Older, smaller machines have been shut down and dismantled or converted to the production of groundwood specialties. Larger newsprint units have been installed, replacing the smaller machines.

Since 1981, the Canadian industry has idled 18 newsprint machines with a total capacity of 855,000 metric tons. During the same period, nine new newsprint machines with an estimated total capacity of 1.390 million metric tons have been built.

Closely associated with this has been the closure since 1981 of four groundwood specialties machines with a total capacity of 80,000 metric tons. One groundwood specialties machine has been installed and another 800,000 metric tons of capacity have come on-stream as a result of conversions of smaller newsprint machines. Newsprint and groundwood specialties have become hard to distinguish in calculating capacity because a number of the machines making them are mixed-product units.

Three options are possible for upgrading newsprint

NORTH AMERICAN NEWSPRINT CAPACITY EXPANSIONS, 1987-91 (continued)

Company	Mill	Capacity (000 metric tpy)	Startup
Proposed			
Bear Island	Ashland, Va.	200*	n.a.
Donohue Normick	Amos, Que.	160*	n.a.
Normick/Forex[16]	Val d'Or, Que.	225*	n.a.
Smurfit Newsprint	Newberg, Ore.	275*[17]	n.a.
Westbrook Wood Products	Medford, Oregon	n.a.	n.a.
Daishowa America	Port Angeles, Wash.	200*	n.a.
Alcan Aluminium[18]	Vanderhoof, B.C.	n.a.	n.a.
Cascades	Port Cartier, Que.	225*	n.a.
CIP/Kenaf International	Texas	215*	n.a.

* New newsprint machines.

1. New 160,000-tpy machine replaces older unit.
2. Rebuild of two machines followed by shutdown of two older units.
3. New 180,000-tpy machine replaces 40,000-tpy unit.
4. Rebuild of two paper machines, with No. 2 machine completed in 1987 (adding 90,000 tpy) and No. 7 completed in 1988 (adding 162,000 tpy).
5. Recycled newsprint machine restarted January 1988.
6. Restarted idled No. 8 machine in January 1988.
7. Conversion to directory paper.
8. Estimated newsprint capacity increase after rebuild of No. 2 newsprint/groundwood papers machine.
9. Recycled newsprint.
10. New company consisting of major shareholder CIP Inc. and seven other partners.
11. Partnership between Great Lakes Forest Products Ltd. and five publishers.
12. Subsidiary of Abitibi-Price Inc. and the New York Times Co.
13. Investor group headed by Vancouver, B.C., businessman Ronald Stern in partnership with unidentified private Canadian companies.
14. New 240,000-tpy unit replaces two older machines.
15. New company formed by Canfor Corp. and Oji Paper.
16. Two Quebec-based forest products companies. (Normick Perron Inc. has 42% share of Donohue Normick Inc.'s Amos, Que., mill.)
17. Net may be smaller because some machines at Oregon City may be converted to groundwood papers.
18. Company proposed greenfield newsprint mill to be built jointly with interested forest products company, using power from Alcan's hydroelectric plant in Kemano.

Source: *Pulp & Paper Week.*

machines to groundwood specialties: change in basis weight, increase in brightness, or improvement in finish, according to Magnus Diesen of Jaakko Pöyry International Oy. To lower basis weight, a cleaner, lower-freeness mechanical pulp is required, and chemical pulp content must be increased to boost strength. A change in the bleaching process often is required. Hydrosulfite bleaching may be adequate with some fiber, but southern pine may require a switch to peroxide bleaching, which raises capital and operating costs. With borderline-quality wood, it may be possible to sort out the better wood for groundwood specialties production, reserving the lower-quality wood for chemical pulp or newsprint production. The groundwood machine's stock and whitewater systems may also require separation from the rest of the mill to retain brightness.

If the mill chooses to upgrade its finish by adding a supercalender, it will probably want to sort the wood in the woodyard in order to isolate the fresher and whiter wood. Low-freeness pulp is also particularly important for supercalendered (SC) paper, and careful screening is a must. Most SC paper mills run with two supercalenders, which may cause layout problems in an existing mill.

Troubled Canadian industry. A study of competitiveness in the newsprint industry among Canada, the U.S. West, the U.S. South, Sweden, Norway, and Finland by Price Waterhouse Associates for the years 1982 and 1983 indicated that Canada had the highest manhours and labor costs per ton of output. Capacity of the average

ESTIMATED ANNUAL NEWSPRINT CAPACITY OF MAJOR COMPANIES

(000 metric tons)

	Canada	U.S.	Total	Capacity share (%)
Abitibi-Price	1,732	349	2,081	13.5%
CIP	1,095	—	1,095	7.1
Bowater	212	855	1,067	6.9
Consolidated-Bathurst	927	—	927	6.0
Kruger	802	—	802	5.2
Champion International[1]	—	754	754	4.9
Kimberly-Clark[2]	343	404	747	4.8
Boise Cascade	246	484	730	4.7
Quebec & Ontario Paper	714	—	714	4.6
MacMillan Bloedel	707	—	707	4.6
Smurfit Newsprint[3]	—	541	541	3.5
Crown Forest Industries	466	—	466	3.0
B.C. Forest Products	452	—	452	2.9
North Pacific Paper	—	451	451	2.9
Reed	413	—	413	2.7
Donohue	402	—	402	2.6
Great Lakes Forest Products	395	—	395	2.6
Rothesay Paper	312	—	312	2.0
Garden State Paper	—	310	310	2.0
Great Northern Paper	—	287	287	1.8
Domtar	285	—	285	1.8
Stone Container[4]	—	264	264	1.7
Southeast Paper	—	192	192	1.2
Bear Island Paper	—	191	191	1.2
James Maclaren Industries	168	—	168	1.1
F.F. Soucy	165	—	165	1.1
Stora Forest Industries	—	158	158	1.0
James River[5]	—	41	41	0.3

Total North American capacity (1987): 15.415 million tons*
Capacity of top five producers: 38.7%
Capacity of top ten producers: 62.4%

* American Paper Institute and Canadian Pulp & Paper Assn.
[1] Former St. Regis Corp. mill. Bought by Champion International Corp. in 1984.
[2] Includes 343,000 metric tpy at Spruce Falls Power & Paper Co. Ltd.
[3] Jefferson Smurfit Corp. bought 80% interest in 1986.
[4] Former Southwest Forest Industries Inc. mill. Bought by Stone Container Corp. in 1987.
[5] Former Crown Zellerbach Corp. mill. Bought by James River Corp. in 1985.

Canadian paper machine was the lowest at 97,000 metric tpy, compared with Sweden at 148,000 tpy. The report found that it takes Canadian mills six manhours to produce a ton of newsprint, while Sweden can do it in half the time.

Canada's ranking, however, changed with currency exchange rates relative to the Nordic countries. In a study commissioned by Canada's Forest Sector Advisory Council, Canada's ranking moved from sixth to fourth highest cost producer among the same regions. Canada still had the lowest average annual capacity per machine at 96,000 metric tpy, compared with the high in Finland of 170,000 tpy. Labor costs were also highest in Canada in 1986.

As shown in the level of machine productivity, pulping technology, and other elements of mill operations cited in the Price Waterhouse report, obsolescence continued to be a factor in the Canadian newsprint industry. It was noted that the productivity advantage of the other regions was due to a much higher level of investment.

Canadian newsprint machines are generally older than those in the U.S., dating back to the 1920s and 1930s, with most three decades old. Despite speedups and rebuilds, these relatively inefficient machines in some cases cannot compete with modern fourdrinier and twin-wire paper machines. U.S. mills also have the advantage in costs for fiber and transportation. However, finance costs at U.S. mills are higher.

The level of foreign exchange for Canadian currency is a crucial economic factor bearing on the competitiveness and profitability of the Canadian newsprint industry. For example, a 3% to 4% differential in the Canadian-U.S. dollar exchange rate in 1987 caused Canadian mills to lose half of a $35/metric-ton price increase that had been implemented at the beginning of the year.

Canadian newsprint producers in recent years have been upgrading older machines by installing twin-wires and shutting down older machines and replacing them with more modern units. At the same time, the U.S. has been moving ahead with expansion plans. The share loss of the U.S. market by Canadian producers was expected to worsen in the early 1990s, due to capacity additions planned in the U.S. This could be somewhat offset by the many upgrades planned for Canadian mills during the period 1987-90, which will give Canadian producers a more even cost advantage with the U.S.

Another problem for the Canadian industry has been labor relations. Province-wide strikes in British Columbia

CANADIAN NEWSPRINT AND GROUNDWOOD SPECIALTIES CAPACITY CHANGES, 1982-87

(metric tons)

	Newsprint	Groundwood specialties
Capacity 1981	9,490,000	660,000
Machine closures (1982-1987)		
1982 Abitibi-Price, Grand Falls, Nfld.	35,000 (1)*	
Consolidated-Bathurst, Grand-Mère, Que.	—	15,000
1983 Abitibi-Price, Iroquois Falls, Ont.	130,000 (4)	—
Abitibi-Price, Sault Ste. Marie, Ont.	—	20,000 (1)
Consolidated-Bathurst, Shawinigan, Que.	40,000 (1)	—
Consolidated-Bathurst, Grand-Mère,Que.	—	15,000 (1)
MacMillan Bloedel, Powell River, B.C.	50,000 (1)	—
Quebec & Ontario Paper, Thorold, Ont.	220,000 (5)	—
1985 Abitibi-Price, Iroquois Falls, Ont.	50,000 (1)	—
MacMillan Bloedel, Powell River, B.C.	50,000 (1)	—
1986 Maclaren, Buckingham, Que.	160,000 (2)	—
CIP, Gatineau, Que.	80,000 (1)	—
1987 Abitibi-Price, Kenogami,Que.	—	30,000 (1)
Donohue, Clermont, Que.	40,000 (1)	—
Increases in capacity, 1982-1987		
New machines	1,390,000 (9)	80,000 (4)
Conversions to groundwood specialties	—	800,000
Capacity 1987	10,025,000	1,450,000

*( ) represents number of machines involved.

Source: *Canadian Paper Analyst.*

and sporadic work stoppages in eastern Canada have made publishers wary of the Canadian producer's long-term reliability. The Canadian Paperworkers Union represents most unionized workers throughout the country and traditionally bargains province-wide, as in British Columbia, or it selects a target company with which to negotiate and then applies a master agreement to subsequent negotiations, as in eastern Canada.

The trend of past labor problems could be changing. Strikes have been kept to a minimum in recent years. In 1986, British Columbia mills bargained an agreement quickly and without incident. In 1987, eastern Canadian negotiations progressed rapidly and without major work stoppages, enabling a contract to be signed within weeks of the expiration of the old agreement on April 30.

Newsprint demand. Newsprint consumption in the U.S. totaled 12.350 million metric tons in 1987, an increase of 3.5% from the previous year's all-time high, according to API. The strongest regional demand growth was in the South, which accounted for 31.0% of total U.S. consumption in 1987, up from 27.7% in 1975. Demand in the West rose to 22.5% from 18.7% over this same period for the second fastest growth. Meanwhile, demand in the Northeast declined to 25.5% from 26.4%, while the Midwest turned in the worst performance, with consumption dropping to about 21% from 27.2%.

Newsprint demand is best determined by the performance of the daily newspaper industry because it is by far the chief consumer of newsprint, comprising close to 75% of total U.S. consumption in 1987. Advertising and circulation figures are watched closely to determine how much newsprint will be consumed.

Daily newspaper circulation has been on a fairly level trajectory since the early 1970s, but it declined 0.5% in 1985 and 0.4% in 1986, according to ANPA. In contrast to daily sales, Sunday circulation has been gaining ground; it increased an average of 1.5%/year between 1980 and 1985 and a robust 4.6% in 1986.

Modest circulation growth in conjunction with lineage gains has kept newsprint consumption climbing upward. Overall, U.S. newsprint consumption rose at an average annual rate of 2.8%/year between 1980 and 1986 to 13,153,000 short tons. In 1986, the gain in newsprint consumption measured a slightly higher 3.0%. These consumption gains compare favorably with real GNP growth, which was 2.4% between 1980 and 1986 and 2.5% in 1986, according to API reports.

Between 1974 and 1984, U.S. newsprint consumption rose at a 2.1% compound annual rate while real GNP advanced 2.8%. However, in three of the last four years (1983-86), newsprint consumption grew at a faster rate than real GNP, reflecting increased advertising in newspapers and growth in newspaper inserts, advertising shoppers, and free community weekly newspapers. Such uses for newsprint have grown to about 25% of total U.S. newsprint consumption, an increase from about 23% in 1980.

Real newspaper advertising revenues grew 1.6% in 1986, according to data compiled by the Newspaper Advertising Bureau and deflated by API. That gain was almost in line with the 1.5% average rate of increase recorded between

NORTH AMERICAN NEWSPRINT INVENTORY TRENDS

(000 metric tons)

Year	Consumption (U.S.)	Year-end stocks held by all U.S. consumers	Days of supply held at year's end by U.S. consumers	Year-end stocks held by all mills in North America
1987	12,350	1,382	44	388
1986	11,937	1,269	42	326
1985	11,587	1,394	46	346
1984	11,431	1,329	45	358
1983	10,589	1,179	42	402
1982	10,108	1,258	47	342
1981	10,164	1,477	56	232
1980	10,088	1,090	42	186
1979	10,199	877	34	178
1978	9,864	970	38	204
1977	9,281	1,070	43	287
1976	8,670	1,206	52	297
1975	8,325	903	44	105
1974	9,262	1,052	48	151
1973	9,741	753	32	197
1972	9,551	667	26	252
1971	8,922	885	38	338

Source: Canadian Pulp & Paper Assn.

1980 and 1985, but it followed three years of sharp volatility during which real newspaper advertising revenues spurted 5% in 1983 and 5.8% in 1984, before weakening 0.5% in 1985. Fluctuations in newspaper circulation and advertising lineage contributed to short-term variations in newsprint demand.

Although newspapers have remained the leading medium in terms of advertising revenues, their share of overall media advertising revenues has contracted during recent years. While newspapers accounted for 27.6% of total current-dollar media advertising revenues in 1980, their share had declined to 26.4% by 1986.

Because newspaper advertising rates have risen more substantially than overall media rates since 1980, the erosion in market share is even more severe when measured in constant 1982 dollars. Specifically, newspapers' share of total real advertising revenues contracted from 27.5% in 1980 to 25.1% in 1986. These setbacks occurred at a time when the combined real market share of the print media rose from 51.6% to 53.6%, mainly due to the strength of the rapid gains in direct-mail advertising.

Newsprint prices. In soft markets, when demand is low and supplies are plentiful (such as in the early 1980s), prices either flatten or decline. Prior to the 1980s, North American newsprint prices were dominated by the actions of a few Canadian producers, generally called "the club" by U.S. publishers. A combination of rapid capacity addition in North America and elsewhere and the unusually strong North American currencies produced a surplus of U.S. and Canadian tonnage available for sale in the U.S. In addition, an influx of paper from previously less important sources such as Scandinavia, continental Europe, Latin America, and South Africa helped lead to the club's demise.

From 1981 until 1986, prices vacillated while remaining virtually flat for the period due to deep discounting. Price increases were attempted at the same time as publishers were offered special cuts; after several failures to raise list levels in the mid-1980s, posted prices were successfully raised during fourth-quarter 1986.

Newsprint producers pushed through a $35/metric ton price increase in late 1986 to a new list of US$570 in the eastern U.S. Another price increase in July 1987 raised the

ESTIMATED TOTAL MONTHLY NEWSPRINT INVENTORY HELD BY U.S. CONSUMERS

(000 metric tons/weeks of supply)

	1987		1986		1985		1984		1983		1982	
Month	**Tons**	**Weeks**	**Tons**	**Weeks**	**Tons**	**Weeks**	**Tons**	**Weeks**	**Tons**	**Weeks**	**Tons**	**Weeks**
Jan.	1,324	41	1,413	45	1,429	46	1,257	42	1,254	45	1,559	56
Feb.	1,360	40	1,435	44	1,489	46	1,258	41	1,272	45	1,634	58
Mar.	1,367	40	1,405	42	1,541	48	1,221	38	1,247	42	1,666	59
Apr.	1,360	40	1,409	42	1,527	47	1,194	37	1,230	42	1,629	59
May	1,323	40	1,371	42	1,482	48	1,263	42	1,177	42	1,598	62
June	1,405	44	1,360	45	1,475	50	1,430	48	1,258	47	1,565	62
July	1,472	43	1,410	43	1,521	49	1,497	48	1,262	45	1,530	57
Aug.	1,457	41	1,438	43	1,563	48	1,508	47	1,311	43	1,497	52
Sept.	1,509	41	1,451	41	1,527	45	1,478	44	1,293	41	1,423	48
Oct.	1,442	39	1,392	40	1,506	44	1,453	42	1,234	38	1,360	46
Nov.	1,361	40	1,161	39	1,448	46	1,389	45	1,219	41	1,328	47
Dec.	1,382	44	1,269	42	1,394	46	1,335	45	1,179	42	1,258	47

	1981		1980		1979		1978		1977		1976	
Month	**Tons**	**Weeks**	**Tons**	**Weeks**	**Tons**	**Weeks**	**Tons**	**Weeks**	**Tons**	**Weeks**	**Tons**	**Weeks**
Jan.	1,166	43	947	34	1,002	36	1,074	41	1,323	50	901	36
Feb.	1,234	44	1,036	36	1,029	36	1,084	40	1,366	49	883	36
Mar.	1,286	45	1,058	38	1,027	35	1,165	41	1,353	47	1,048	39
Apr.	1,311	46	1,097	40	950	33	1,130	41	1,326	46	1,123	41
May	1,312	49	1,147	43	907	34	1,156	44	1,250	46	1,131	44
June	1,395	54	1,195	47	938	37	1,207	48	1,268	49	1,200	49
July	1,462	54	1,208	45	991	37	1,194	47	1,261	47	1,273	49
Aug.	1,455	51	1,213	43	1,024	35	1,209	45	1,297	44	1,357	49
Sept.	1,460	49	1,212	40	938	31	1,195	42	1,262	40	1,349	47
Oct.	1,481	50	1,180	39	911	30	1,193	39	1,230	40	1,351	47
Nov.	1,480	54	1,092	39	881	31	1,050	37	1,206	42	1,364	51
Dec.	1,447	56	1,090	42	877	34	970	38	1,180	43	1,333	52

Source: Canadian Pulp & Paper Assn.

list to $610 in the East and to $600 in the West. This was followed by a $40 hike on Jan. 1, 1988, to a new posted level of $650.

Actual price increases were even larger as producers tightened up on discounts that had driven transaction prices in 1986 down to around the $470 to $480/metric ton range. Some spot sales by both North American and offshore mills in the first half were down into the low-$400 range.

U.S. newsprint prices were soft through the whole 1982-86 period due to overcapacity, erratic U.S. economic growth, and the strength of the U.S. and Canadian dollars, which hurt North American newsprint exports and attracted imports from Scandinavia. The period began with an official list-price reduction from $500 to $468.50/metric ton in October 1982. The list was then raised to $535/metric ton in the third quarter of 1984, but this level was increasingly discounted going into 1985 and 1986.

Such pricing caused the Canadian newsprint industry to decline sharply in the early 1980s. Jim Rowland of *Canadian Paper Analyst* estimated that pre-interest, pretax profit of Canadian producers on shipments to the U.S. declined from a high of about C$125/metric ton in 1980-81 to a low of C$50 in 1983 before recovering to about $100 in 1986.

But the success of the late-1986 price hike marked the dawning of a new cycle for the newsprint industry, one in which the producers would call the shots. Because of limited newsprint capacity expansions through the end of the decade, mills were expected to continue raising prices through 1988 to new levels as high as $700/metric ton in the eastern U.S.

OUTLOOK

Most analysts expect U.S. newsprint supply to be tight through 1988, thanks to limited capacity expansion. In addition, the presidential election and the Olympic Games should help domestic consumption in 1988, and export shipments will be healthy as long as the U.S. and Canadian dollars remain weak. If a recession occurs in 1989, as many forecasters predict, operating rates might decline, but they would still be at a favorable level of at least 95%, which is high by historical standards.

Total Canadian newsprint shipments in 1987 grew 4.9% to 9.8 million metric tons. Shipments to the U.S. increased 5.2% to 7.1 million tons, while shipments to Canada jumped 5.4% to 1.18 million tons and offshore shipments eased up 2.8% to 14.9 million tons. Total Canadian shipments in 1988 are projected to increase nearly 2%, with shipments to the U.S. increasing about the same amount and exports outside North America rising by only 1%, according to CPPA forecasts. This should result in an operating rate of about 98% for Canadian mills, up from 97% in 1987 and 94% the preceding year.

Demand for Canadian newsprint in the U.S. will be helped by an estimated 2% or more increase in newsprint consumption, inventory building by publishers, and limited capacity expansion by U.S. newsprint producers. Publishers will increase inventories because of labor negotiations in British Columbia and because of expected price increases. One factor that could hurt demand is an unusually narrow price gap that has developed between newsprint and higher groundwood grades. This could encourage substitution of

WORLD CAPACITY FOR NEWSPRINT

(000 metric tons)

Year	Canada	U.S.	Scandinavia	Western Europe (except Scandinavia)	Japan	Others	Total
1987p	10,025	5,410	4,515	3,140	2,865	6,639	32,594
1986	9,885	5,360	4,515	3,115	2,840	6,421	32,136
1985	9,820	5,325	4,525	2,950	2,780	6,041	31,441
1984	9,820	5,305	4,630	2,755	2,720	5,754	30,984
1983	9,970	5,235	4,685	2,510	2,730	5,467	30,597
1982	9,935	5,130	4,380	2,490	2,710	5,331	29,976
1981	9,490	4,950	4,045	2,440	2,885	5,031	28,841
1980	9,130	4,420	3,930	2,505	2,770	4,951	27,706
1979	9,065	3,810	3,860	2,440	2,710	4,586	26,471
1978	8,980	3,710	3,640	2,410	2,640	4,346	25,726
1977	8,985	3,690	3,430	2,250	2,480	4,205	25,040
1976	9,000	3,641	3,283	2,190	2,350	3,921	24,385
1975	8,974	3,582	3,088	2,506	2,296	3,526	23,972

p = Preliminary.

Source: Canadian Pulp & Paper Assn., *Newsprint Data*.

1987 NEWSPRINT EXPORTS FROM MAJOR PRODUCING COUNTRIES

(000 tons)

Major Importers	**Exporter**				
EUROPE	U.S.	Canada	Sweden	Finland	Norway
Belgium	—	5	44	43	29
Denmark	—	—	110	86	38
France	—	22	90	115	25
Germany, Fed. Rep.	1	131	380	199	104
Greece	—	—	21	21	23
Italy	—	15	53	28	26
Netherlands	—	30	122	55	74
Portugal	—	4	19	12	7
Spain	—	5	39	33	25
Sweden	—	—	—	6	—
U.K.	1	292	336	401	144
Other	—	4	46	72	36
Total Europe	2	508	1,260	1,071	531
NORTH AMERICA					
Canada	4	—	—	1	—
U.S.	—	7,259	218	192	66
Total North America	4	7,259	218	193	66
ASIA/AUSTRALASIA					
Australia	1	112	4	27	9
China	2	78	20	10	7
Hong Kong	17	39	13	3	8
India	—	51	2	4	3
Indonesia	—	—	—	—	—
Iran	—	—	12	1	—
Japan	182	152	17	15	2
Malaysia	—	28	15	6	9
Singapore	—	18	22	5	—
Taiwan	14	32	3	—	7
Thailand	4	26	8	2	21
Other	36	14	88	49	42
Total Asia/Australasia	257	550	204	122	108
LATIN AMERICA					
Argentina	1	10	—	—	—
Brazil	—	90	5	23	—
Colombia	4	74	1	4	—
Costa Rica	—	13	—	0	—
Dominican Rep.	—	13	—	—	—
Ecuador	—	12	—	—	—
El Salvador	—	5	—	—	—
Guatemala	—	8	—	—	—
Mexico	3	10	—	—	—
Panama	—	12	—	—	—
Peru	—	20	—	1	1
Puerto Rico	—	67	—	0	—
Trinidad & Tobago	—	2	—	—	—
Venezuela	12	67		8	—
Other	16	24	1	2	—
Total Latin America	35	427	7	38	1
AFRICA					
Egypt	11	23	11	3	—
Nigeria	—	—	2	0	2
Other	—	3	26	5	16
Total Africa	11	26	39	13	18
WORLD TOTAL	308	8,771	1,728	1,437	726

Source: *Pulp & Paper International*, Annual Review, July 1988.

coated groundwood and SC paper for newsprint in inserts and other commercial printing applications.

U.S. newsprint mills in 1987 increased shipments 3.8% to 5.3 million metric tons, resulting in an operating rate of 95.0%. In 1988, the U.S. should increase shipments by 2% to 3% for a 99.5% operating rate. With North American capacity rising only about 1.1% in 1988 and U.S. consumption increasing by 2.0% to 3.0%, operating rates for U.S. and Canadian mills should be around 98.5% of capacity. These operating rates indicate a seller's market, and prices should continue to climb.

In the long term, Jon G. Udell, who wrote "A Look into the Future: the U.S. Economy, Newspapers and Newsprint Consumption in 1995," expected U.S. demand for newsprint to reach 12.9 million metric tons by 1990 and 14.5 million metric tons by 1995. This is based on a 2.5% average annual expansion of the GNP.

Said Udell, "The future outlook for U.S. newspapers is favorable even though the U.S. economy may experience some difficult days in the years ahead. If difficulty does not occur, the 14.5-million-ton trend projection for 1995 will be exceeded. In fact, if newspaper and newsprint consumption were to repeat the growth rates of 1975-85, U.S. newsprint consumption would reach 16.3 million metric tons in 1995. However, one can strongly question whether newsprint supply would allow such a rapid expansion."

In a more recent forecast released in December 1987, Udell predicted a U.S. newsprint consumption of 12.5 million metric tons in 1988, provided the economy did not slip into a recession. His forecast of a minimum 14.5 million tons in 1995 was not changed.

A long-term newsprint forecast prepared by Chase Econometrics for CPPA called for U.S. consumption to increase at a 1.8%/year rate over the 1986-1991 period, down from a 2.3% rate between 1980-85. The slower growth rate reflects lower use of newsprint in preprinted inserts as advertisers use more lightweight coated paper. In addition, newspapers are expected to make greater use of non-newsprint paper. However, aging of the baby-boom generation should increase consumption of newsprint, as should a rise in newspaper circulation. The forecast expected regional U.S. newsprint consumption to shift slightly away from the South and Midwest toward the Northeast and West over the next five years.

Overseas markets. World consumption of newsprint in 1984 was 29 million metric tons, according to the Food and Agriculture Organization of the United Nations. In a 1986 report by the FAO, world newsprint growth rates were projected to rise above the 1970-82 average of 2% to

WORLD DEMAND FOR NEWSPRINT

(000 metric tons)

Year	North America	Western Europe	Asia, Africa, Oceania	Eastern Europe	Latin America	Total
1986	12,933	6,445	6,257	1,933	1,432	29,000
1985	12,684	6,107	6,186	1,891	1,272	28,140
1984	12,651	6,039	5,868	1,821	1,184	27,563
1983	11,479	5,589	5,574	1,761	1,170	25,573
1982	10,822	5,424	5,342	1,669	1,184	24,441
1981	11,593	5,628	5,661	1,707	1,538	26,127
1980	11,280	5,640	5,322	1,647	1,326	25,215
1979	11,075	5,355	5,174	1,694	1,192	24,490
1978	10,700	5,079	4,879	1,683	1,088	23,429
1977	9,966	4,796	4,624	1,716	1,169	22,271
1976	9,821	5,092	4,311	1,694	962	21,880
1975	9,029	4,975	4,064	1,670	924	20,662
1974[1]	10,437	5,622	3,672	1,613	1,358	22,702
1973	10,661	5,497	3,446	1,532	1,264	22,400
1972	10,059	5,100	3,388	1,509	1,295	21,351
1971	9,517	4,979	3,263	1,467	1,285	20,511
1970	9,533	5,269	3,173	1,418	1,449	20,844
1969	9,688	5,113	2,958	1,337	1,297	20,393
1968	9,080	4,553	2,595	1,264	1,184	18,676
1967	8,887	4,222	2,355	1,200	1,084	17,748
1966	8,998	4,419	2,077	1,095	985	17,574

1. Figures prior to 1974 do not include People's Rep. China.

Source: Canadian Pulp & Paper Assn., *Newsprint Data*.

approximately 3% in 1995, when world consumption reaches 39 million metric tons.

The largest share of total 1986 North American newsprint exports remained Canadian—more than four times as much newsprint as from the U.S. Exports of U.S. newsprint, however, grew between 1980 and 1986 from 176,000 metric tons to 299,100 tons, while Canadian newsprint exports shrank from 1.524 million metric tons to 1.446 million tons.

Exports to western Europe from North America—with the largest amount originating in Canada—declined between 1980 and 1986. North American exports to the Pacific rose, with the fastest growth in the Far East. South America, on the other hand, has imported less newsprint from Canada but more from the U.S. in recent years.

Since 1980, the Scandinavian producers have had an edge in trading with western Europe. In that time, the European Economic Commission imposed a tariff-free import quota of 650,000 metric tpy of non-EEC-produced newsprint, while newsprint from Scandinavia entered western Europe tariff-free.

Exports to the U.K. from Canada dropped significantly in the mid-1980s, due not only to falling newspaper circulation but also to the currency exchange rate, increased imports from Scandinavia, and increased production within the U.K. This trend continued in the late 1980s.

NEWSPRINT PRICES, 30-LB DELIVERED

(U.S. $/metric ton)

	Eastern			West Coast		
	List	Transaction	Effective	List	Transaction	Effective
1987						
4Q	$610	$570		$600[1]	$552.90	
3Q	610	570	7/1 - 9/1	600	552.90	7/1
2Q	570	553/550		570	514.50	
1Q	570	530/550		570	514.50	
1986						
4Q	570	500/550	10/1 - 12/30	570	514.50	10/1
3Q	535	500/535		535	508.25	
2Q	535	480/535		535	508.25	
1Q	535	500/535		535	508.25	
1985						
4Q	535	505		535[2]	508.25	
3Q	535	510		535	508.25	
2Q	535	510		535	508.25	
1Q	535	510		535	508.25	
Year-end						
1984	535	510	7/1	500/535	508.25	3/1, 10/1
1983	500	475	9/1	468.50[3]	445	
1982	468.50	445/468.50	11/1	468.50	445	8/1
1981	470/500	490	1/1, 8/1	470/500	470	1/1, 8/1
1980	440	440/470	5/1	440	440	5/1
1979	380/413	380/413	1/1 - 2/1, 10/1 - 11/1	380/413	380/413	1/1 - 2/1, 10/1 - 12/1
1978	353	353	2/1 - 4/1	353	353	4/1
1977	336	336		331	331	
1976	314/336	314	3/1, 11/1 - 12/1	331	331	7/1
1975	287	284	1/1	309	309	1/1
1974	259	259	7/1	270	270	8/1
1973	199/206/235*	220	2/1, 6/1, 11/1	197/235	197/235	1/1, 9/1 - 12/1
1972	194*	182	2/1	192	192	1/1
1971	188*	176	4/1	182	182	1/1
1970	179*	168	1/1	173	173	1/1

* Prices are for paper made by Canadian mills; prices in these years for southern-manufactured paper are generally about $2 lower. Effective dates for Canadian and southern mills are generally the same, except for 1972, when southern price took effect a month later on 3/1.

1. One previously implemented 5% discount reduced to 3%, effective 7/1/87.
2. A second 5% discount added by West Coast producers, effective 10/1/85.
3. West Coast producers announced 5% discount from list, effective 7/1/83.

Sources: American Newspaper Publishers Assn.; *Pulp & Paper Week.*

While South American markets may not be as promising for Canadian producers, the Latin American/Caribbean market was Canada's third largest newsprint export market in 1986, and it should remain bullish. People's Rep. China and Australia should also be opening up to more Canadian newsprint. African imports, however, are expected to drop. For the U.S., Japan should remain the leading export market primarily due to Jujo Paper Co. Ltd.'s interest in the North Pacific Paper Corp. mill in Longview, Wash.; Daishowa America Inc.'s ownership of the Port Angeles, Wash., mill; and Oji's partnership in the new Howe Sound venture with Canfor. Asian markets also look promising for future U.S. newsprint shipments, with the four leading consumers being Malaysia, Indonesia, Hong Kong, and Singapore. U.S. exports to Latin America are expected to continue declining.

U.S. consumption of imported newsprint slowed in 1987. Sweden, Norway, and Finland drew back considerably from the U.S., a result of more favorable exchange rates in the European market. U.S. imports of newsprint from suppliers other than Canada were down 25% during the early part of the year, but supply shortages onshore later in the year boosted offshore imports 23.4% higher than in 1986, according to CPPA.

U.S. NEWSPRINT CONSUMPTION, DAILIES vs OTHER USES*

(000 metric tons)

	ANPA "525"	Other dailies	Other uses	Total consumption
1985	7,199	1,525	2,863	11,587
1984	7,075	1,457	2,899	11,431
1983	6,638	1,260	2,700	10,598
1982	6,358	1,249	2,501	10,108
1981	6,506	1,307	2,351	10,164
1980	6,581	1,208	2,299	10,088
1979	6,673	1,208	2,318	10,199
1978	6,446	1,174	2,257	9,877
1977	6,143	1,084	2,052	9,279
1976	5,928	1,020	1,771	8,719
% change				
1976-1985	21.4%	49.5%	61.7%	32.9%

* American Newspaper Publishers Assn. (ANPA) data for both the ANPA "525," and other dailies are actual; with "Total consumption" a calculated number, the "Other uses" category represents the balance.

Source: *Canadian Paper Analyst.*

LARGEST U.S. DAILIES AND 1986 NEWSPRINT USAGE

Newspaper	Circulation*	Newsprint consumption** (metric tons)
Wall Street Journal	2,026,276	168,510
New York Daily News	1,278,118	172,918
USA Today	1,311,792	130,000
Los Angeles Times	1,117,952	385,000
New York Times	1,056,924	337,400
Washington Post	796,659	236,778
Chicago Tribune	758,464	202,737
New York Post	740,123	58,620
Detroit News	678,399	132,660
Detroit Free Press	639,720	93,080

* From Audit Bureau of Circulation figures as of Mar. 31, 1987.
** Independent verification.

Source: "Newspaper and Newsprint Facts at a Glance," from Newsprint Information Committee.

EXPORT PRICES FOR NEWSPRINT IN SELECTED MARKETS

(per metric ton)

	Canada to U.K.[1]		Finland to U.K.[2]	
	C$	US$	£	US$
1987				
4Q	C$670.06	US$505.90	£400*	US$656.80
3Q	657.92	498.05	400*	647.60
2Q	677.75	508.31	400*	657.60
1Q	656.03	490.05	365*	561.73
1986				
4Q	621.50	449.34	365*	521.95
3Q	674.25	486.80	345	513.70
2Q	563.05	407.08	345	520.60
1Q	603.07	429.99	345	488.52
1985				
4Q	622.79	451.52	345	494.38
3Q	621.80	457.64	345	475.41
2Q	557.71	407.69	345	434.70
1Q	551.37	407.46	315	352.80
Year-end				
1984	489.17	371.28	321	390.66
1983	527.75	426.42	300	441.60
1982	606.44	492.43	300	494.47
1981	615.37	516.30	300	564.60
1980	631.44	533.57	270	644.22

*Discounting from list prices reported.
1. F.o.b. point of lading, 30-lb.
2. Delivered to U.K. pressroom, 48.8-g/m^2.

Sources: *Statistics Canada*; Lamco Paper Sales Ltd.; Johnson, Jorgensen & Wettre Ltd.

COMPARATIVE NEWSPRINT MANUFACTURING COSTS FOR MAJOR PRODUCING REGIONS, 1986

(U.S. $/metric ton)

	Canada	**U.S. West**	**U.S. South**	**Finland**	**Sweden**	**Norway**
Furnish material	$112	$129	$93	$176	$156	$132
Energy	56	75	75	87	79	35
Labor	82	54	67	38	60	53
Other	49	56	80	45	62	45
Mill level cost	299	314	315	346	357	265
Corp./selling cost	20	9	16	24	17	12
Cost before delivery	319	323	331	370	374	277
Delivery	62	45	28	70	55	67
Total delivered cost	381	368	359	440	429	344

HISTORICAL TREND IN TOTAL NEWSPRINT DELIVERED COST, 1982-88

(U.S. $/metric ton)

	1988*	**1986**	**1985**	**1984**	**1983**	**1982**
Norway	$399	$344	$326	$260	$297	$360
Canada	408	381	379	385	407	408
U.S. West	368	368	378	388	370	387
U.S. South	359	359	379	384	379	368
Finland	523	440	409	331	369	384
Sweden	491	429	388	306	312	322

* *Pulp & Paper Week* estimate based on year-end exchange rates except for 1988, which is based on prevailing exchange rate in early January, but excluding effect of inflation (which has been higher in Nordic countries.)

Source: Forest Sector Advisory Council of Canada, "Newsprint Cost Study, 1982-86."

SHARE OF PRINT-BASED ADVERTISING REVENUES

(millions of constant 1982 dollars)

Year	**Total real advertising revenues**	**Real print-based advertising revenues**	**Newspaper advertising revenues**	**% print**	**% newspaper**
1986	$79,324	$42,459	$19,874	53.5%	25.1%
1985	77,410	41,372	19,557	53.4	25.3
1984	76,632	40,777	19,651	53.2	25.6
1983	70,822	37,166	18,576	52.5	26.2
1982	66,580	34,468	17,694	52.0	26.6
1981	66,407	34,548	18,163	52.0	27.4
1980	65,868	33,957	18,130	51.6	27.5

Sources: McCann-Erickson Inc. and American Paper Institute.

UNCOATED GROUNDWOOD

GRADE STRUCTURE

Uncoated groundwood papers and newsprint are similar in terms of physical properties, but uncoated groundwoods are manufactured to have better printing characteristics and are priced above standard newsprint. They fall between newsprint and coated paper as an intermediate printing medium, with the exception of the small (230,000 short tpy in 1987) North American groundwood forms paper sector, which competes with uncoated free-sheet forms bond. One characteristic distinguishing uncoated groundwoods from competing products is brightness. Whereas newsprint brightness ranges from 56 to 62 Elrepho, uncoated groundwood grades start at about 64 and may go as high as 72. These ratings are below those of coated groundwoods, which are in the low to medium 70s, and uncoated groundwood is considered to be below coated groundwood in overall printing qualities. It does offer better endurance and a better printing surface than newsprint, however.

Many existing uncoated groundwood machines originally made newsprint and then were upgraded to produce groundwood specialties when they ceased to be economical competitors in the newsprint industry. This trend accelerated significantly in the mid-1980s due, at first, to overcapacity in newsprint plus increasing customer demands for papers with improved appearance characteristics. Methods of upgrading a newsprint machine's output to uncoated groundwood include the addition of fillers, use of more chemical furnish, and additional on-machine calendering or off-machine supercalendering.

Supercalendered (SC) papers of various qualities currently are produced, or soon will be produced, by several Canadian newsprint manufacturers. These mills will compete with SC grades from the U.S. and Europe. The Scandinavians have introduced high-quality SC grades and an intermediate grade between premium SC and coated No. 5. Indeed, two Finnish mills, Kymi Kymmene Oy and United Paper Mills Ltd., shipped 35,000 tons of this on-machine coated, lightly pigmented lightweight grade to the U.S. in 1987. Mills in Fed. Rep. Germany, Austria, and Finland also planned to ship this new coated groundwood grade.

In addition, Canada's largest newsprint producer, Abitibi-Price Inc., is hoping its superpremium SC grade, WSOP (web-sized offset paper), will outperform and outsell

STATISTICS FOR UNCOATED GROUNDWOOD PAPER*

	1988e	1987	1986	1985
UNITED STATES				
Production, 000 tons	1,613	1,491	1,540	1,521
Capacity,[1] 000 tons	1,865	1,756	1,685	1,644
Utilization rate, %	86.5	84.9	91.4	92.5
Imports, 000 tons	1,602	1,270	1,028	1,027
Exports, 000 tons	51	56	41	37
Apparent U.S. consumption				
000 tons	3,164	2,705	2,527	2,511
lb/capita	25.80	22.26	20.98	21.05
000 tons/$ billion real GNP (1982)	0.64	0.71	0.68	0.70
CANADA[2]				
Production, 000 tons	1,683	1,475	1,343	1,146
Capacity, 000 tons	1,772	1,598	1,391	1,146
Exports, 000 tons	1,382	1,253	1,138	992
Utilization rate, %	94.9	92.3	96.5	100.0

* All tons are short tons.
e = Estimate.
1. American Paper Institute.
2. Canadian Pulp & Paper Assn.

its nearest competitors, including LWC (lightweight coated). WSOP is licensed to Abitibi by Metsäliiton Teollisuus Oy of Finland. The rebuilt paper machine at the Kenogami mill in Jonquière, Que., produces about 70,000 tons of paper when operating at full capacity.

Lake Superior Paper Industries Inc., a project of Pentair Inc. and Minnesota Power, is using technology from the German Haindl Papier GmbH to make up to 240,000 short tpy of premium SC paper. The Duluth, Minn., mill began operations in November 1987. A second machine is possible.

Some of the typical end uses for uncoated groundwood, with approximate 1987 North American demand estimates, are: catalog, 400,000 tpy of uncoated groundwood; directory, 650,000 tpy; newspaper insert and direct-mail advertising circular, 600,000 tpy; periodicals (magazine and Sunday supplement), 850,000 tpy; some business papers, including forms and carbonless basestock, 240,000 tpy; and miscellaneous end uses including books, basestock for converting into various products, and export, in excess of 300,000 tpy. The basis-weight range is normally 18 to 40 lb (24 x 36 in., 500 sheets) or 30 to 66 g/m².

The large retailers such as Sears, Roebuck & Co., Spiegel, and J.C. Penney, along with another 6,500 specialty stores, mail-order houses, and other merchandisers, are the primary consumers of catalog-grade papers. A major catalog publisher, Montgomery Ward, dropped its catalog business in 1985 to focus on retail sales, but Ward still uses uncoated groundwoods, along with other printing papers, as advertising inserts in newspaper and direct-mail campaigns. A study by Resource Information Systems Inc. estimated that in 1985 almost 1.9 million tons of all kinds of papers were used by catalog merchandisers. RISI estimated that 13.7% was SC, 9.5% machine-finished, 40% coated No. 5, and 33.4% coated Nos. 3 and 4.

UNCOATED GROUNDWOOD PAPERS TYPICAL GRADE STRUCTURE

Grade	Basis weight[1]
Rotogravure[2] (standard, premium, high brightness)	33, 35 lb (25 x 38 in., 500 sheets)
Offset[2] (premium, high brightness)	28, 35, 38, 45 lb (25 x 38 in., 500 sheets)
Magazine (gravure, offset)	35 lb (25 x 38 in., 500 sheets)
Paperback/book	35, 37 lb (25 x 38 in., 500 sheets)
Directory (white, yellow)	20, 22.5 lb (24 x 36 in., 500 sheets)
Computer	15, 18 lb (17 x 22 in., 500 sheets)

1. Typical weights offered by producers. Other weights may be available.
2. Catalog grades.

Sears estimated that its use of uncoated groundwood papers for catalogs and advertising will rise from about 40% in 1987 to 52% of all papers used in 1988. The primary grade to gain will be SC-A, which will shoot from around 17% to about 34% of all papers used.

Catalogs are printed by both the rotogravure and offset processes, although gravure printing is favored for longer runs because of its economic advantages. Paper quality is such a significant consideration that a large number of catalog publishers have introduced some LWC paper into their publications to enhance appearance. Traditional catalog paper also has suffered from competition from SC paper—again, for reasons of enhanced appearance. A very few publishers may use lower-quality grades, such as high-brightness newsprint and standard newsprint.

Directory paper, used primarily for telephone directories, generally has a lower gloss and brightness than catalog paper and, for telephone books, is generally made in the 22- to 23-lb basis-weight range, although some publishers are experimenting with 20-lb and 18-lb paper. The breakup of American Telephone & Telegraph Co. and court decisions that allow anyone to produce yellow pages directories have spurred, at least temporarily, strong growth in directory publishing. The number of alternative and specialty directories, such as Business-to-Business, Silver Pages (for senior citizens), and ethnic or market-related books, is also growing. Growth in this area is expected to last through 1989.

Around 650,000 to 700,000 tons of directory paper were purchased by North American directory printers and publishers in 1987, following purchases of about 650,000 tons in 1986 and 588,000 tons in 1985. Use is expected to average 3.6% annually through 2000, when usage should reach about one million tons annually, according to the American Assn. of Yellow Pages Publishers. AAYPP members publish 85% of the directories in the U.S. Members include all seven of the regional Bell operating companies, GTE, and Donnelly Directory Co.

GPO MINIMUM ACCEPTABLE PROPERTIES FOR GROUNDWOOD PAPER FORMS

Basis weight				
lb*	12	15	18	20
g/m²	45	56	68	75
Burst	7	8	11	14
Opacity, %	80	80	80	80
Caliper				
0.001 in.	2.8	3.5	4.2	4.6
mm	0.071	0.089	0.109	0.117

* Ream size: 17 x 22 in., 500 sheets.

Larry Small, AAYPP's marketing manager, said some publishers believe that fewer and fewer white pages directories will be published as the costs of production rise. In addition, Small expects a shakeout in the industry that could mean the demise of many of the 200 smaller directory publishers currently in the field.

Advances in printing technology and demands for better printing quality also could change the outlook for current directory paper stock. Four-color process printing and growing use of cover advertisements and inside coupons all add up to needs for stronger and brighter papers.

SC paper is becoming a major commodity in uncoated groundwood markets, either in the "SC magazine paper" category occupied by the major SC producers—Lake Superior Paper Industries, 240,000 tpy; Madison Paper Corp., 165,000 tpy; and Champion International Corp., 120,000 tpy—or in the "SC newsprint" category, occupied by an increasing number of newsprint mills that are adding supercalenders to produce slightly upgraded newsprint paper. The term "SC magazine paper" is sometimes used to indicate a sheet that would be used in Europe for magazines or in North America for an increasing number of Sunday newspaper supplement magazines, because its surface is similar to coated No. 5 papers, while "SC newsprint sheet" is a lower-quality, lower-priced product.

SC papers are relatively new to the North American market, although they have been used extensively for years in European magazines. The grade is catching on, however, with publications such as *Parade*. Over 100,000 tons of SC paper were used in 1985 for Sunday magazines and supplements, about a third of that amount by the *New York Times*. SC papers are believed to represent a market in North America of at least 1.0 million tpy.

Some new projects are in the works for the late 1980s.

U.S. PRODUCTION AND CAPACITY FOR UNCOATED GROUNDWOOD PAPER

(000 short tons)

	Production		
	Census	API[1]	Capacity[2]
1990p	—	—	1,917
1989p	—	—	1,882
1988p	—	—	1,865
1987	—	1,485	1,756
1986	1,574	1,540	1,685
1985	1,564	1,521	1,710
1984	1,723	1,565	1,622
1983	1,604	1,531	1,642
1982	1,499	1,471	1,655
1981	1,428	1,471	1,625
1980	1,538	1,499	1,624
1979	1,800	1,509	1,537
1978	1,636	1,354	1,453
1977	1,589	1,360	1,367
1976	1,560	1,321	1,309
1975	1,294	1,127	1,329
1974	1,411	1,192	1,280
1973	1,416	1,181	1,403
1972	1,308	1,126	1,442
1971	1,186	1,089	1,363
1970	1,214	1,085	1,230
1969	1,208	1,095	1,296

p = Preliminary.
1. Shipments.
2. American Paper Institute, 1988.

Sources: American Paper Institute, Bureau of the Census.

ESTIMATED CAPACITIES FOR UNCOATED GROUNDWOOD PAPER OF MAJOR COMPANIES

(000 short tons)

	1988 Annual capacity		Capacity N. American market	
	U.S.	Canada	Total	%
1. Abitibi-Price	—	440	440	9.6%
2. MacMillan Bloedel	—	435	435	9.5
3. CIP	—	425	425	9.3
4. Consolidated-Bathurst	—	380	380	8.3
5. Boise Cascade	—	325	325	7.1
6. GN Nekoosa[1]	303	—	303	6.6
7. Champion Intl.[2]	275	—	275	6.0
8. Domtar	—	190	190	4.1
9. Kimberly-Clark	131	41	172	3.8
10. Madison Paper	165	—	165	3.6
11. Lake Superior Paper	160	—	160	3.5
12. St. Raymond Paper[3]	70	80	150	3.3
13. James River	140	—	140	3.1
14. Fraser	135	—	135	2.9
15. St. Marys Paper	—	135	135	2.9
16. Daishowa America[4]	120	—	120	2.6
17. Kruger	—	55	55	1.2

North American capacity (1988): 4.580e million tons
U.S.: 1.865; Canada, 2.715[5]
Capacity share of top five companies: 43.8%
Capacity share of top ten companies: 67.9%

e = *Pulp & Paper* estimate.
1. Millinocket, Maine.
2. 1987 production.
3. Includes Pejepscot Paper, Brunswick, Maine.
4. Purchased newsprint/groundwood mill from James River, 1988.
5. CPPA estimates 1988 capacity at 1.664 million tons; does not include rotonews and some other groundwood capacity.

St. Marys Papers Inc. is building a new SC machine in Sault Ste. Marie, Ont., bringing mill capacity to 250,000 tpy in 1988, and Lake Superior Paper completed its 240,000-tpy greenfield mill in late 1987. The attractive prospects facing SC in the marketplace, as discussed later in this chapter, may continue to interest papermakers in such investments.

Clay filler content is the second major factor affecting grading of SC papers, along with the supercalendering operation itself. SC papers have a clay content ranging from almost nothing to 25% or more to enhance appearance. Fairly intricate adjustments in calendering and clay content can be made on the machines, thus allowing an SC mill to vary paper quality. In fact, in the entire uncoated groundwood market, mills have been switching capacity to uncoated groundwood from other products at a rapid rate, and the wide variety of market and production strengths of these mills has dictated an increasing range of marketing approaches by producers.

A strong market for uncoated groundwood paper is business forms, a market that has been growing by 15% to 35% annually in recent years and is expected to almost double between the mid-1980s and mid-1990s. Groundwood forms are used for computer printouts, generally for companies' internal sales documentation and reports. This grade represents a low-cost alternative to free-sheet forms bond. List price differential between groundwood and free-sheet forms paper has been close to $200/ton, with a free-sheet/groundwood blend priced more or less in between. Groundwood papers account for less than 8% of all paper shipped to forms converters, the rest being free-sheet and some coated grades. That may double by 1995. However, one industry observer suggested that in weak markets, such as the situation in 1981-83, discounts can erode the price advantage of blends and even of groundwood forms, thus slowing growth of the groundwood product. Also, there is some question as to whether demand for groundwood forms will slow as customer resistance to its inferior appearance compared with free-sheet closes off further penetration into the office.

Ronald W. Hinding, vice president of manufacturing at Uarco Inc., told delegates at the Third Uncoated Groundwood Papers Conference that forms-grade groundwood papers fall into three categories:

- Low-content groundwood papers that exhibit a high brightness. They contain 10% to 50% groundwood fiber, and brightness levels range from 72 to about 77. These papers are similar to uncoated free-sheet and forms bond in

UNCOATED GROUNDWOOD PAPERS: CANADIAN PRODUCTION, EXPORTS, AND CAPACITY

(000 short tons)

	Production[1]	Exports[2]	Capacity[1]
1987	1,475	1,253	1,598
1986	1,343	1,138	1,391
1985	1,146	992	1,146
1984	1,000	845	1,020
1983	843	575	882
1982	715	460	827
1981	711	320	728
1980	677	305	728
1979	625	321	702
1978	580	266	675
1977	463	193	560
1976	363	133	480
1975	315	140	402
1974	401	183	440
1973	319[3]	184	412

1. Canadian Pulp & Paper Assn.
2. *Statistics Canada.*
3. *Pulp & Paper* estimate.

UNCOATED GROUNDWOOD EXPANSIONS

Company	Location	Annual short tons	Startup	Nature of work
Abitibi-Price	Jonquière, Que.	65,000	1987	Convert to WSOP SC
Lake Superior	Duluth, Minn.	240,000	1987	New SC mill
Abitibi-Price	Alma, Que.	65,000	1988	Convert to LW catalog & directory
St. Marys Paper	Sault Ste. Marie, Ont.	172,000[1]	1988	Build new SC machine
St. Raymond Paper	St. Raymond, Que.	incremental	1988	New headbox installation
St. Raymond Paper	Pejepscot, Maine	70,000	1988	Restart idled specialties machines
F.F. Soucy	Rivière du Loup, Que.	22,000	1989	Rebuild news/groundwood machine
Consolidated-Bathurst	Grand-Mère, Que.	202,000[2]	1990	Build new specialties machine
Daishowa America	Port Angeles, Wash.	150,000	proposed	Build new directory machine

1. 110 tpy net if No. 1 machine mothballed as planned.
2. 125 tpy net; replaces Nos. 8 and 9 machines.

Sources: *Pulp & Paper Week, Pulp & Paper Project Report.*

appearance and in performance in computer applications. These papers often are used in lieu of register bond in stock continuous forms, and colored papers in this grade sometimes are substituted for colored free-sheet papers.

- Papers with over 50% groundwood content and low brightness of about 65. This is the largest grouping of groundwood forms.
- Papers used as basestock for carbonless forms. These papers range from 70 to 74 brightness and are used primarily for multiple-part stock continuous forms. They are known as low-ply chemical carbonless papers.

Groundwood forms bond does have some drawbacks when compared with free-sheet stocks. Aside from the more obvious disadvantage of having a lower brightness than free-sheet, groundwood has a tendency to age rapidly. Though groundwood papers are now made much better than during their major introduction into the market in 1973-74, users still prefer uncoated free-sheet for archival purposes or for external presentation. Thus, custom continuous forms often use free-sheet, while groundwood is acceptable for internally used and quickly discarded stock continuous forms.

A shortage of uncoated bond papers in 1973-74 caused converters to look at groundwood as an alternative, but early stock was plagued with serious problems, including:

- Poor refoldability, which can slow down operations of a high-speed printer.
- Lint on the surface of the sheet, which wears out printer ribbons faster than normal.
- Inadequate internal strength, causing line holes to rip apart on some fast printers, leading to jamming of the printer.
- Inability to punch cleanly, leaving punch holes—"chad"—in place to jam the printer.
- Abrasiveness, which causes converters' line hole punches and perf blades to wear out more quickly than with free-sheet forms paper.

Advances in cleaning and refining of groundwood pulps are helping to cut down problems such as premature filling of forms printers' press plates and blankets. These printing problems require excessive stops for cleanup and are a particular problem with printers who use fast flying-splice setups requiring consistent operations for the sake of cost-effectiveness.

LIGHTWEIGHT (CATALOG/DIRECTORY) PAPER CAPACITIES—NORTH AMERICA

(000 metric tons)

Company	Capacity	Mill producing
Champion[1]	275	Lufkin, Texas; Deferiet, N.Y.
GN Nekoosa[2]	190	Millinocket, Maine
MacMillan Bloedel	150	Port Alberni, Powell River, B.C.
Daishowa	141	Port Angeles, Wash.
James River	140	Clatskanie, West Linn, Ore.
Abitibi-Price	133	Beaupré, Alma, Que.
Fraser[3]	130	Madawaska, Maine
Consolidated-Bathurst	70	Trois Rivières, Ville de la Baie, Que.

1. St. Regis Div.
2. Probably higher than estimate.
3. Owned by Noranda Forest Inc.

Sources: *Pulp & Paper* estimates, company data.

PRODUCTION/CAPACITY

Production of uncoated groundwood papers in the U.S. grew at a rapid rate during the 1970s, but then turned downward during the prolonged economic stagnation that began in 1979 and continued into the early 1980s. Production again turned upward in 1983 and has gained every year since then, except for 1985. Indeed, from 1976 to 1986, production of uncoated groundwoods (as measured in shipments by the American Paper Institute) increased almost 16.6% from 1.321 million tons in 1976 to 1.540 million tons ten years later. Production was just under 1.5 million tons in 1987.

A more detailed analysis shows the market's variability: shipments in 1980 fell 0.7% to 1.498 million short tons after a very strong 1979, when shipments jumped 11.4% to 1.509 million tons. Another drop—1.8% to 1.471 million tons—occurred in 1981, and shipments showed no measurable growth or loss in 1982. In 1983, however, shipments rebounded 4.1% to 1.531 million tons. Uncoated groundwood papers in 1984 took a smaller advance of 2.2%, or 1.565 million tons.

In 1985, shipments fell 3.1% to 1.516 million tons, followed by a meager 0.5% increase to 1.520 million tons in 1986, and then a drop of 3.2% in 1987.

Canadian production has risen steadily since 1980, a year in which production increased 8.6% over 1979. Likewise, production rose 4.7% in 1981, 0.6% in 1982, 17.9% in 1983, 19.7% in 1984, 14.6% in 1985, 16.3% in 1986, and 11.3% in 1987, according to the Canadian Pulp & Paper Assn. These figures may not be accurate because U.S. government definitions of uncoated groundwood and newsprint for tariff purposes include rotonews with newsprint, for example. Thus, Canadian production of groundwood specialties in 1986 is listed by CPPA at 1.331 million short tons, whereas a more accurate number would be at least 1.8 million tons, and maybe even substantially above 2.0 million tons. Thus, it is also difficult to determine the trends in Canadian output.

More accurate figures are available on U.S. uncoated groundwood production because domestic producers make little rotonews. U.S. uncoated groundwood capacity in 1987 was about 1.756 million short tons, up from 1.685 million tons in 1986, according to estimates by API. Capacity rose about 4.2% in 1987, and it is expected to increase another 6.2% to 1.865 million short tons in 1988, API said. CPPA figures show 1.279 million short tpy of Canadian capacity in that year. The actual figure may be higher because of the reasons previously mentioned.

Canadian producers are expected to increase uncoated groundwood capacity by 3.9% in 1988, after a 10.8% increase in 1987, according to official CPPA figures. Incremental additions of uncoated groundwood capacity may be implemented by Domtar Inc. in Donnacona, Que.; Consolidated-Bathurst in Grand-Mère, Que.; and CIP Inc. in Trois Rivières, Que. A proposal for a greenfield SC mill in Matane, Que., has been abandoned by Donohue Inc. in favor of a market pulp mill.

OUTLOOK

The final years of the 1980s should prove upbeat for uncoated groundwood mills because of increased demand from a variety of end use markets. These are expected to consume significantly more paper as the period progresses. But overcapacity may be a problem in 1989 and 1990, according to John D. Maine of RISI. Maine expected demand to be restricted by a mild recession in late 1989 and 1990 and by renewed availability of newsprint and LWC. "Secondly," he said, "the tremendous amount of capacity growth, particularly in Canada, will begin to catch up with the market in 1989." Maine projected that North American demand for uncoated groundwood paper will grow 500,000 short tons by 1990, yet capacity will increase 934,000 short tons.

At the beginning of 1987, more than 800,000 tons of potential new LWC came online, causing an erratic decline in list and transaction pricing that affected uncoated groundwood markets, particularly premium SC grades, which subsequently also suffered price erosion. Because of increased end-user demand, inventory building, and production problems at several of the startups, prices for coated groundwood moved substantially higher later in the year and also at the beginning of 1988, pulling uncoated groundwood grades along.

The magazine market is indicative of the markets in which coated and uncoated groundwood grades vie for customers. Catalogs are another major battleground. Earlier in the decade, coated paper was in short supply, and uncoated groundwood mills were able to take up the slack. Now, uncoated and coated groundwoods will meet head-to-head to capture a magazine market that was lackluster through 1986 and only marginally better in 1987.

Better pricing in 1986 and early 1987 and improved quality also encouraged some uncoated groundwood buyers to switch to coated papers, especially in catalog, insert, supplement, and cents-off-coupon printer markets. That trend was partially behind the desire of uncoated paper mills to consider installing supercalenders to offset some of the move to coated. Both coated and uncoated mills may suffer from a technological innovation that makes it possible to inexpensively retrofit old newsprint machines with coaters.

The volatile markets of 1984 and 1986-87 may have caused substantial grade-shifting and intergrade competition, which in turn caused uncoated groundwood mills to play catch-up in an attempt to offset the natural advantage held by coated mills. Except for situations such as that in late 1987 when coated paper became overpriced for some users, uncoated groundwood papers often will be the second choice for many publishing and printing end uses.

Cost pressures on small, specialized publications could spur them to increase the use of cheaper uncoated papers. On the other hand, many of the Sunday newspaper magazines, including the *Washington Post*'s, have moved up to coated paper to improve their quality. Directories will continue to consume mostly uncoated groundwood paper, and many observers expect strong growth to continue in groundwood forms.

The superpremium WSOP grade to be produced at Abitibi-Price's Kenogami mill and the SC-A from Lake Superior could prove to be strong competitors for magazine orders. That competition already is evident. As European paper markets rebounded from the recession of the early 1980s, American customers demanded more of the quality magazine-grade paper that European mills make. It seemed at the time that 1985 would be the tightest market for coated and uncoated groundwood paper in many years. But, in 1986 and 1987, Europe as well as North America began experiencing a glut of coated groundwood, which caused a substantial cut in prices and possibly some loss of the North American market. On the other hand, new European

NEW AND PROPOSED NORTH AMERICAN SUPERCALENDERED CAPACITY

Company	Mill	Capacity (000 short tons)	Date
CIP	Trois Rivières, Que.	70	1987
Abitibi-Price	Jonquière, Que.	65	1987
Lake Superior Paper[1]	Duluth, Minn.	240	1987
St. Marys Paper	Sault Ste. Marie, Ont.	125 (net)	1988
Madison Paper	Madison, Wis.	182	1988-89
Consolidated-Bathurst[2]	Grand-Mère, Que.	202	1990

1. Partly owned by Pentair Inc.
2. 110,000 tpy net.

grades continued to take some business from North American mills, and most offshore mills vowed to keep their shares of the market.

The U.S. imported almost 1.3 million tons of uncoated groundwood paper in 1987, mostly from Canada, according to U.S. Dept. of Commerce figures. That is obviously on the low side because CPPA reported that shipments to the U.S. of groundwood printing and specialty grades from Canada alone were almost 1.1 million tons in 1987 That does not account for groundwood papers classified as newsprint or for offshore papers, so the U.S. probably imported close to two million tons in 1987.

End users in the U.S. are looking north for both paper *and* printing, as has K-Mart, which is the second largest U.S. retailer. K-Mart also buys a small but significant portion of its paper from Finnpap, the consortium of Finnish paper mills. In 1987, the department store agreed to double its purchases of SC-A paper from Finnpap to 72,000 short tpy from 1988 to 1990. K-Mart uses more than 200,000 tons of paper annually, most of it SC-A.

K-Mart also delivered some bad news for the paper industry late last year when officials announced the company would reduce its newspaper-insert advertising budget by some $40 to $45 million. The money will be used instead for television, other promotions, and in-store events, according to published reports. The move is part of K-Mart's attempt to appeal to a broader, more affluent audience.

European producers will soon have to look beyond growth in European demand for sales. In fact, European mills expect to increase practical production capacity of all mechanical pulp papers (including newsprint) by almost 25% from 1986 through 1991, which will put net capacity three times above expected demand, according to the European Paper Institute's 1987 Paper Capacity Report.

Even with cutbacks in planned projects (i.e., those that had not yet been approved by May 1987, but were likely), capacity will far outstrip demand. A retreat from some projects may reduce the potential for overcapacity, but EPI is still wary. "Until that starts to take effect, overcapacity will remain a major threat and challenge to the viability of this growing sector of the European paper industry," the report stated.

SC magazine paper, which makes up the bulk of groundwood paper other than newsprint, will experience continuing capacity increases, rising 14.6% from about 2.9 million tons in 1986 to 4.6 million tons in 1991.

SC magazine papers will suffer from stagnant or possibly declining demand, especially in print advertising, where coated papers will gain market share. However, exports of both SC and coated papers to non-European countries, especially the U.S., will remain at present levels, EPI analysts predicted.

The remaining portion of European uncoated groundwood paper will advance 34.5% during those five years, but tonnage relative to other sectors will remain small, hitting almost 1.3 million tons in 1991, up from 932,000 in 1986, EPI reported. Demand for these grades will increase about 3%/year.

Not all the news is equivocal. Just as coated groundwoods have taken away customers of uncoated groundwoods because of their demand for higher-quality papers, higher-value uncoated groundwoods have benefited from a quality shift from newsprint. This occurred as more

CANADIAN UNCOATED GROUNDWOOD PAPER EXPORTS

(short tons)

Destination	1987	1986	1985	1984	1983	1982	1981	1980
U.K.	23,590	n.a.	n.a.	n.a.	505	n.a.	7,325	9,432
Benelux	n.a.	n.a.	n.a.	30	n.a.	n.a.	n.a.	1,549
Hong Kong	1,867	3,695	3,188	2,876	1,226	2,867	4,285	7,484
Singapore	0	n.a.	n.a.	n.a.	n.a.	2,078	3,972	2,77[illegible]
Japan	132	56	10,556	10,647	9,248	n.a.	23	n.a.
Philippines	0	n.a.	n.a.	13	n.a.	1,739	1,[illegible]42	1,312
Thailand	0	n.a.	1,688	2,574	483	786	n.a.	1,595
Other Asia[1]	n.a.	n.a.	43	142	110	1,068	109	572
Australia	2,127	1,216	2,798	4,161	2,331	8,189	3,387	18,434
Colombia	0	1,351	2,244	1,922	2,752	1,571	4,087	2,101
Venezuela	11,381	n.a.	n.a.	n.a.	1,217	n.a.	981	n.a.
Other Latin America[1]	n.a.	1,348	1,150	720	1,387	1,652	794	1,070
U.S.[2]	938,826	658,129	544,212	695,312	556,048	439,338	292,460	258,768
Total	993,020	665,862	566,473	718,637	575,307	459,288	318,265	305,090

n.a. = Not available.

[1] Not necessarily same countries each year.

[2] Believed to be lower than actual groundwood imports to U.S.

Source: *Statistics Canada* (commodity class 351-49).

bottom-end inserts and Sunday supplements, which had resisted the move to rotonews or high-brightness offset in earlier years, finally were driven into higher grades because of the demands of advertisers, competition from customers, and improved appearance of daily newspapers' run-of-paper sections.

Fairly stable growth rates of 5%/year are expected for the next several years in major end-use markets for uncoated groundwood. For example, directory paper, according to several industry estimates, will grow at an average 3.6% annually through 2000 at the seven regional Bell operating companies (RBOC's). This will bring usage of 22.5-lb yellow to one million tons that year, up from 588,000 tons in 1985. The growth is slower than the high single-digit or low double-digit rates experienced by the independent publishers, which use from 15% to 20% of the paper tonnage consumed by directories. Directory publishing is a $6-billion/year industry.

The late Wayne J. Nelson, director of manufacturing and publishing support services for Pacific Bell Directory, told delegates at the Third Uncoated Groundwood Papers Conference in Montreal in November 1987 that growth for all of the U.S. RBOC's and independent publishers should be about 5% for 1988 over 1987. This includes paper from 18-lb to 30-lb.

UNCOATED GROUNDWOOD PAPER: U.S. EXPORTS AND IMPORTS

(000 short tons)

	Exports[1]	Imports[2]
1987	56	1,270
1986	41	1,527
1985	37	1,367
1984	30	1,298
1983	37	920
1982	56	653
1981	120	650
1980	101	688
1979	80	695
1978	58	611
1977	54	443
1976	71	338
1975	74	84
1974	53	110
1973	29	120
1972	18	142
1971	10	156
1970	7	218

1. Prior to 1978, Census classification was groundwood paper, printing, writing and converting, uncoated. From 1978, classification was printing and writing papers, over 10% mechanical pulp, uncoated.

2. Prior to 1978, Census classification was uncoated book and printing paper with over 25% mechanical pulp. From 1978, classification was the same except for mechanical pulp content, which was reclassified as over 10% mechanical pulp.

Source: Bureau of the Census.

"This growth will come from several sources including increased advertising and distribution, but it will also come from the rash of new products being introduced on an almost daily basis across the country," Nelson said. "However, a significant portion of this growth in consumption will not necessarily be of the old '22.5-lb' variety."

Nelson explained that heavier-weight paper, such as 26-lb, will be needed to allay complaints of ink show-through on ads. A move to higher basis weights also "bulks up" small products. This is primarily true for yellow pages.

Some of the advertising enhancements include more use of four-color spot color, led primarily by Donnelly Directory. Donnelly developed Markolor, which gives the look of four-color process, but uses only yellow, black, and red inks. Currently, Donnelly is printing Markolor on 22.5-lb paper, but the AAYPP's Larry Small suggested that heavier paper would be needed if the practice becomes more prevalent. Some critics say the Markolor process is not yet very good, but use of four-color printing probably will continue to grow. Nelson felt that publishers are not likely to pay for development of a sheet for spot four-color printing.

White directory paper will move the other direction to 18-lb and 20-lb as a cost-saving measure, said Nelson. Directories may also use small amounts of other groundwood and nongroundwood papers for such enhancements as coupon sections, and some still use newsprint.

The outlook, though, is not all rosy. Larry Small of the AAYPP said that most in the industry feel there will be a shakeout of publishers, possibly in two to five years or at least by the end of the century, which is less than 12 years away. "The yellow pages industry is like any other industry in that once you reach saturation, the weaker people are going to fall by the wayside." Already, companies such as GTE, which sell lists of telephone subscribers to the independent publishers, have raised their prices, making it more expensive for the independents. This may cause a reduction in size for independent directories and/or force some smaller publishers to seek their fortunes elsewhere.

Some directory publishers and printers also are looking at printing by the flexographic process, though only trial runs have been made so far. Nelson gave the following reasons for why flexography is attractive:

- much less ink ruboff through use of water-based inks,
- 10% less paper waste on press makeready, and
- more vivid color reproduction.

The long-term outlook for demand for both directory and catalog papers is clouded by the possibility of competing services being offered by electronic mechanisms. Some researchers think the potential for videotext or electronic yellow pages is impressive. It has been estimated that between 20 to 30 million households could use this service by 1990. It has not yet been a major factor and may take time to catch on, but the increasing use of personal computers will certainly help it. Videotext systems installed in corporate locations are expected to grow 69% annually over the next five years.

Also available are phone-in yellow pages that provide updated advertising information to callers. Tele-Direct (Publications) Inc., the publishing arm of Bell Canada Enterprises Inc., was due to bring online an electronic yellow pages in early 1987, but for use only by government workers to find needed services and products in the private sector. The French national telephone company installed Mini-Tel computer terminals in homes and offices. These systems include easy access to phone numbers and addresses. Elsewhere, talking yellow pages, like videotext, will take some time to make serious inroads against printed directories.

Electronic terminals and video catalogs such as the Home Shopping Network also could have an effect on catalogs, if they ever reach the home in large numbers. Catalog publishers and other merchandisers expect to see a significant switch to electronic means, although probably not before the mid- to late-1990s. Sears tried an experiment in 1981 by supplying customers a videodisk catalog. Washington, D.C.-area stores and 1,000 homes equipped with videodisks received disk catalogs in addition to paper catalogs. A Sears official told an API meeting in late 1981, "In our judgment, the Sears catalogs will never be completely supplanted by electronics," and added that it should be six or seven years before "the electronic revolution makes its first modest inroads into the use of paper in the catalog business." Most observers today would probably move that threshold forward another ten years.

Though Sears did not find its customers quick to accept the new CD-ROM (compact disk/read-only memory) system, the economics of the idea seemed attractive to the company; the Sears executive estimated that 90% of the $250 million/year his company spends producing catalogs goes into printing and distribution, with the remaining 10% apparently applied to such costs as photography and text writing. Therefore, an electronic system that could cut the 90% portion substantially would be attractive to catalog publishers.

More immediate is the threat to paper catalogs from cable-television home-shopping programs, even though actual purchases through this medium have slid somewhat. Sears and other retailers are, in fact, working out deals for appearances and ownership interests in such programs. Printed catalogs, and thus paper producers, could be affected. For instance, industry analysts suggest that SC paper will account for about 16% of the catalog paper market by 1995, up from 4% in 1986. Some of that growth will come at the expense of machine-finished grades, as well as from general growth in catalogs.

Electronics also is creating opportunities for groundwood producers who manufacture basestocks for papers used in office computer printers and so-called intelligent photocopy machines. The number of high-speed electronic printers installed in the U.S. is expected to continue rising, and the number of small, inexpensive, and less sophisticated computer printers is expected to grow rapidly. Businesses are increasingly using intelligent copiers to generate forms on plain paper instead of using preprinted forms. Free-sheet papers are expected to retain their strong lead in this area, but groundwood papers could expand their position as well.

The North American forms industry is still experiencing healthy growth, but individual companies will face decreasing profitability, fierce competition, and lowered entry barriers, according to an annual study by International Business Forms Industries Inc. (IBFI).

In "Perspective '87: The Present and Future of the North American Forms Industry," Douglas Taylor, IBFI's director of economic and market research, said the industry's principal product is becoming more mature, with growth slowing down to closely match general economic growth. Taylor expected U.S. forms-industry growth to average 4% to 5% through the end of the decade, unless current economic expansion slows or reverses. This means an

UNCOATED GROUNDWOOD PAPERS: U.S. PRICE HISTORY

($/ton, year-end)

	Directory (22.5-lb white)	SC-A (34-lb)	Premium roto news
1988*[1]	$750	$780	$652
1987			
4Q	720	740	600-620
3Q	703	710	553
2Q	670	670	517
1Q	(620)/670*	670	517*
1986			
4Q	670	710	570
3Q	670	710	(540)
2Q	670	780*	(540)
1Q	670	780*	(540)
1985			
4Q	670	780*	(540)
3Q	670	780*	(540)
2Q	670	780	567
1Q	670	780	580
1984	670	735	560
1983	650	645	540
1982	650	635	515/520
1981	578	n.a.	500/515
1980	535	n.a.	475
1979	480	n.a.	404
1978	420	n.a.	350/375
1977	n.a.	n.a.	330

n.a. = Not available.

* First-quarter announced price.

1. Prices for other grades vary but the following approximate prices existed in first-quarter 1988: (1) directory, 22.5-lb yellow, $770/ton; (2) offset, 65 bright, 35-lb, $652/ton.

Sources: *Pulp & Paper Week*, *Pulp & Paper Pricebook 2*.

increase in business-forms sales from $6.1 billion in 1986 to almost $7.3 billion in 1991. The strongest growth will be in stock continuous and custom continuous forms, rising 21.6% and 25.8% from 1987 through 1991, respectively.

Corporate restructuring and cost-cutting have led many companies to adopt new office technologies that cut into traditional forms-industry products. The strongest threat probably comes from electronic data interchange (EDI), Taylor said. This will cause slower growth in the 1990s "as forms manufacturers compete head-to-head with computer companies, software houses, and even quick printers for a slice of the office information markets," Taylor explained.

The competition will come from EDI, laser, and other nonimpact printing technologies as well as local-area networks. Forms makers will have to take advantage of these technologies to capitalize on the new markets. This tallies fairly closely with research by Richard Norton of Dataquest Inc., who found that computer printers will continue growing as a major market, although forms bond is likely to face some hurdles. Stock continuous forms bond will grow at 7%/year, from 1.7 million tons in 1986 to 2.4 million tons in 1991. Its sister paper, custom continuous forms, will show almost zero growth over the five years, staying at about 1.2 million tons used annually, Norton said. That is because computer printers now can produce forms from computer software programs.

Preprinted inserts, which are free-standing advertising units created by retailers for distribution in daily or Sunday newspapers, remain an enormous market. This category does not include television program guides, Sunday supplements, specialized magazines, or coupon units. Almost all of the inserts are printed on offset papers, although at least one insert publisher, Quad Graphics, started to market some roto jobs in late 1986. Roto paper inserts are still under severe marketing constraints because of low volume, but costs to advertisers are lower than offset-printed inserts. However, heatset offset printing has been taking away business from coldset offset printing, and it currently represents about half the market, according to Paul L. Hannah, general manager of corporate purchasing in the materials group of R.R. Donnelly & Sons Co.

Hannah told the Third Uncoated Groundwood Papers Conference in 1987 that inserts and flyers grew from 8 billion units in 1970 to 70 billion units in 1986, a compound annual growth rate of 14%. The flyer share of these units has grown from approximately 10% in 1978 to 26% in 1986, along with the growth of audience targeting, Hannah said. Growth may be as high as 12% in 1988, he said, due in part to the U.S. presidential elections and Olympic Games. In the long term, growth may average 8%/year, but a recession could substantially slow that growth rate, as could the postal rate increase in May 1988 and the increasing cost and decreasing availability of paper.

COATED PAPERS

GRADE STRUCTURE

Coated paper is generally categorized into two groups, depending on whether the paper is coated on one side (C1S) or on two sides (C2S). C1S paper represented about 6% of all coated paper production in 1987, and it is generally used for labels. C2S end uses include publications and commercial printing.

The quality of C2S papers ranges downward from a superpremium grade, representing the most expensive and highest-quality sheet, to No. 5, which is at the bottom of the scale in quality and price. Superpremium and Nos. 1-3 essentially are made from chemical pulps, while No. 4 can contain a large amount of mechanical pulp, and No. 5 always contains a high percentage of mechanical pulp. No. 5 papers make up the bulk of coated-paper tonnage, and each successively higher-quality grade is produced in smaller tonnages than the one below it. According to one estimate, No. 1 represented only 5.9% of C2S production in 1987, while No. 2 was 5.0%, No. 3 was 16.2%, No. 4 was 21.8%, and No. 5 was 51.1%.

Some shift in market share occurred among the C2S grades over the last 20 years, with coated No. 5 losing share to Nos. 3 and 4. No. 5's estimated 51% share in 1987 was well above the combined 38% share of Nos. 3 and 4. But in 1971, the split was 27% for Nos. 3 and 4 and 67% for No. 5. Total coated production, including No. 5, rose during this same time.

U.S. STATISTICS FOR COATED GROUNDWOOD PUBLICATION PAPERS

	1988e	1987	1986	1985
Production,[1] 000 tons	3,958	3,785	3,478	3,410
Capacity,[2] 000 tons	4,211	4,132	3,799	3,820
Utilization rates, %	94.0	91.6	91.6	89.0
Imports, 000 tons	510	500	401	393
Exports, 000 tons	59	49	36	44
Apparent U.S. consumption				
000 tons	4,409	4,236	3,843	3,758
lb/capita	35.95	34.85	31.91	31.42
000 tons/$ billion real GNP (1982)	2.28	2.22	2.07	1.05

e = Estimate.

1. *Pulp & Paper* estimates.

2. American Paper Institute capacity for coated groundwood papers—includes coated grade No. 5 and some No. 4.

U.S. STATISTICS FOR COATED FREE-SHEET PUBLICATION PAPERS

	1988e	1987e	1986	1985
Production,[1] 000 tons	3,219	3,080	2,781	2,465
Capacity,[2] 000 tons	3,393	3,237	2,944	2,845
Utilization rate, %	95.0	95.1	94.5	86.6
Imports, 000 tons	125	114	100	103
Exports, 000 tons	58	52	42	39
Apparent U.S. consumption				
000 tons	3,286	3,142	2,839	2,529
lb/capita	26.79	25.85	23.58	21.12
000 tons/$ billion real GNP (1982)	0.69	0.70	0.67	0.70

e = Estimate.

1. *Pulp & Paper* estimates.

2. American Paper Institute survey.

Basis weights for premium coated Nos. 1 and 2 are generally between 60 lb and 100 lb, while Nos. 3 and 4 generally are in the 25- to 90-lb area. Most coated free-sheet is used by commercial printers. The largest end uses are annual reports, catalogs, and other advertising and promotional materials. Coated free-sheet grades also are used by upscale magazines for cover and interior pages. About 10% of No. 3 production is used by magazine publishers.

Most coated groundwood is made in the 32- to 50-lb range (25 x 38 in. in reams of 500), although some 30-lb paper is made and weights can run to 70 lb. End uses include magazines, Sunday newspaper supplements, catalogs, newspaper inserts, directories and other books, and flyers. In the case of lightweight coated (LWC) paper, coat weight may be about 30% of total sheet weight.

A survey of major magazine publishers indicated that demand would increase for papers with basis weights of 40 lb, 38 lb, 34 lb, and 32 lb and below, although none of the increases would be very dramatic. The use of coated groundwood by 98 of the most important magazine publishers was expected to be about 72% of total paper used, slightly higher than the 71.7% in 1986 and the 70.5% in 1985. Coated free-sheet paper would regain some lost ground, accounting for 10.6% of all paper consumed in 1987, after falling to 10.1% in 1986 from a higher rate of 10.8% in 1985.

Different grades are produced to fit the requirements of various printing methods, including letterpress, offset, and rotogravure. Offset papers have grown rapidly in importance, and today they represent the largest portion of C2S publication papers. Offset represented 73% of C2S paper in 1980, up from 55% in 1971 and 19% in 1964, according to one estimate. Letterpress represented 14% in 1980, down from 35% in 1971, while gravure claimed 13% in 1980.

Offset printing papers require a smooth surface and good pick resistance to thwart problems caused by the tacky inks used. Letterpress printing is slightly less demanding of paper-surface properties, but it generally needs heavier basis weights because of a problem with strikethrough in low basis-weight papers. Gravure printing is often used for long press runs that require paper with a smooth surface and controlled ink receptivity.

Quality of image and speed of printing operations dictate which of the various coating methods will be used. Many producers have moved their processes to on-machine coating, although off-machine coating is still common among many of the older commodity-grade coated paper and specialty-grade mills. Most frequently, one coating station applies coating to one side, although the same station can be used to apply coating simultaneously to both sides. Mills also may have coating equipment that applies two coats on the same side, or a precoat may be applied to smooth out surface roughness.

A typical coating solution consists of pigments (kaolin clay, titanium dioxide, or calcium carbonate), binders, and additives to control viscosity and other rheological properties. Delaminated clay is increasingly being used, especially in LWC papers. These coatings provide better runability when combined with conventional kaolins. Several firms are testing even newer forms of coating materials to replace current ingredients.

Excess water must be dried from the coating quickly and efficiently because water makes up as much as 50% of a coating formulation. Common methods are through-air drying, drum drying, and infrared drying. After excess water

TYPICAL PROPERTIES OF COATED PUBLICATION GRADES

General characteristics	Typical use	Basestock	Coating	Brightness
No. 1: Enameled, double-coated, hand-sorted expensive base and coating; high gloss; basis weight above 70 lb	Annual reports	High-brightness chemical pulp; heavily filled	High in TiO_2; high gloss enameled; synthetics	82-88
No. 2: Double-coated, expensive base and coating	Expensive advertising	High-brightness chemical pulp; filled (clay)	High in TiO_2; some clay; synthetics	78-82
No. 3: Single- or double-coated, lower-quality basesheet	Advertising	Chemical pulp; minor amounts of groundwood	Mostly clay; some TiO_2 less expensive	76-82
No. 4: Lower cost, lower brightness	Magazine	Groundwood and chemical pulp; some clay filler	Less expensive; coating—clay and TiO_2	72-78
No. 5: Lower basis weight, high groundwood content	Directories, catalogs, magazines	Mostly groundwood or TMP, chemical pulp for runability	Variable, some contain synthetics	68-72

is removed, the coated sheet is supercalendered if a glossy finish is desired, and it may be supercalendered through the nip of many rolls to further develop the surface gloss. If a high-gloss finish is required, as with an enameled sheet, a gloss calender is used. Dull-finish and matte-finish papers are made by curtailing the use of supercalenders. Dull-finish paper gets little or no pressure from the supercalender, while matte-finish paper goes through a supercalender with one stack that has been sandblasted or engraved to imprint the matte appearance. Matte-finish paper gives a gloss test reading of 20 or less, while dull-finish paper can reach 45 or 55 on the gloss scale. Glossy finish is higher.

Industry sources indicated that in the mid-1980s close to 90% of total C2S paper was glossy, about 10% matte, 3% dull, and a small amount embossed. For Nos. 1-4, about 80% was glossy, roughly 20% matte, 5% dull and less than 1% embossed. No. 5 remained over 90% glossy, although the percentage of No. 5 made with a glossy finish has undergone both upward and downward shifts. Probably 5% of No. 5 is matte and 1% dull, with virtually no embossed No. 5.

In finishing, an increasing percentage of paper in the U.S. is shipped in rolls rather than in sheets. An estimated 85% of coated paper was shipped in rolls in 1980, up from 77% in 1965. The share held by sheeted paper declined to 15% in 1980 from 23% in 1965.

INDUSTRY STRUCTURE

Coated paper production is fairly concentrated. About 28 companies claim most of the industry's capacity, and more than 65% of the capacity is controlled by the top five companies. Within specific areas of the industry, the concentration may be even greater. Nearly one million tpy of new capacity was brought online in North America in 1986 and early 1987. International Paper Co. started up its new machine at Pine Bluff, Ark. (200,000 tpy), at about the same time in the second half of 1986 that machines were started up by Bowater Inc. in Catawba, S.C. (197,000 tpy), and Consolidated Papers Inc. in Wisconsin Rapids, Wis. (180,000 tpy). In Canada, Repap Enterprises Corp. Inc. started up a machine in Newcastle, N.B. (200,000 metric tpy), with most of the output targeted at the U.S. Blandin Paper Co., a subsidiary of British Columbia Forest Products Ltd., is building a 254,000-tpy coated groundwood machine in Grand Rapids, Minn.

These capacity additions came on top of capacity added earlier in the decade by Champion International Corp. in Sartell, Minn. (68,000 tpy), Weyerhaeuser Co. in Columbus, Miss. (175,000 tpy), and Mead Corp. in Escanaba, Mich. (200,000 tpy). The latter two mills can make light- to medium-weight coated groundwood paper of the No. 4 or 5 segments.

U.S. COATED PAPER PRODUCTION

(000 short tons)

		Pulp & Paper estimates[2]			
	Total coated[1]	Coated one-side	Coated two-sides	C2S Nos. 1-4	C2S No. 5
1987	7,604	456	7,148	3,390	3,758
1986	6,260	385	5,875	2,755	3,120
1985	5,860	360	5,500	2,520	2,980
1984	6,249	390	5,860	2,670	3,190
1983	5,675	390	5,285	2,320	2,965
1982	4,970	365	4,605	2,025	2,580
1981	4,880	395	4,485	2,035	2,450
1980	4,615	375	4,240	1,840	2,400
1979	4,642	410	4,230	2,080	2,150
1978	4,593	440	4,155	2,000	2,155
1977	4,274	415	3,860	1,640	2,220
1976	3,890	410	3,480	1,490	1,990
1975	3,076	330	2,740	1,120	1,620
1974	3,739	410	3,330	1,650	1,680
1973	3,757	435	3,320	1,430	1,890
1972	3,455	400	3,055	1,040	2,015
1971	3,165	360	2,805	905	1,900

1. Shipments for both one- and two-side coated papers.
2. May not add up due to rounding.

In production of Nos. 1-3, the top five companies are Scott Paper Co., Westvaco Corp., Mead Corp., Simpson, and Champion International. All have either planned or recently completed further capacity additions. In 1986, Scott's S.D. Warren Div. brought online 200,000 tpy at Skowhegan, Maine, and it is adding an unknown amount of coated free-sheet capacity at Warren's Muskegon, Mich., mill. Mead will add 20,000 to 30,000 tpy in machine speedups and operating improvements. Westvaco is adding 30,000 tpy annually over five years through 1988 at Luke, Md. Midtec Paper Corp., a division of Canada's Repap Enterprises, is building a 205,000-tpy coated free-sheet machine at its Kimberly, Wis., mill. Champion is putting in a 265,000-tpy machine at its Quinnesec, Mich., market pulp mill. And in the first quarter of 1987, Consolidated Papers switched 60,000 tpy of coated groundwood to coated free-sheet.

The expectation of new capacity created problems in 1987, but by mid-year shortages caused some mills to institute allocation programs, and prices started to firm. By the first quarter of 1988, prices were near or above historic levels.

Although coated paper shipments in Canada are not broken out by the Canadian Pulp & Paper Assn., one estimate put total coated paper capacity at 295,000 short tpy in 1985, 400,000 tpy in 1986 (not including Repap Enterprise's new machine), and 635,000 tpy by 1989. These figures include CIS bristol stock.

Canadian coated free-sheet capacity in 1986 was estimated at about 140,000 to 150,000 short tpy, including coated one-side bristol paper made by Domtar Inc. In 1987, Rolland Inc. dropped out of coated paper altogether. The new machine at Repap's Miramichi mill in Newcastle, N.B., which came online in 1986, almost doubled Canada's coated groundwood capacity of 250,000 short tpy.

Strong coated paper demand in the U.S. pushed U.S. imports of Canadian coated to over 200,000 short tons in 1987, nearly all of it coated groundwood.

NEW NORTH AMERICAN COATED PAPER CAPACITY THROUGH 1991

Company, U.S.	Location	Annual short tons	Startup
Bowater	Catawba, S.C.	200,000	1986
Consolidated Papers	Wisconsin Rapids, Wis.	200,000	1986
S.D. Warren/Scott Paper	Skowhegan, Maine	215,000	1986
International Paper	Pine Bluff, Ark.; Jay, Maine; Mobile, Ala.	300,000	1986
Champion International	Sartell, Minn.	175,000	1986
Westvaco	Luke, Md.	90,000	1986-88
Dunn Paper[1]	Port Huron, Mich.	no increase	1987
Mead	Escanaba, Mich.	no increase	1987
Simpson Paper	Pasadena, Texas	n.a.	1987-90
Fraser	Madawaska, Maine	52,000	1988
Midtec Paper/Repap Enterprises	Kimberly, Wis.	200,000	1988
S.D. Warren/Scott Paper	Muskegon, Mich.	n.a.	1988
S.D. Warren/Scott Paper	Westbrook, Maine	n.a.	1988
Blandin Paper	Grand Rapids, Minn.	221,000 net	1989
Potlatch	Cloquet, Minn.	no increase	1989
Champion International	Bucksport, Maine	n.a.	1989
Wausau	Rhinelander, Wis.	25,000	1989
Champion International	Quinnesec, Mich.	265,000	1990
Westvaco	Wickliffe, Ky.	100,000	1990
Weyerhaeuser	Columbus, Miss.	n.a.	n.a.
Unknown	Southeast U.S.	n.a.	late 1991

Company, Canada	Location	Annual metric tons	Startup
Repap Enterprises	Newcastle, N.B.	190,000	1986
Kruger[2]	Trois Rivières, Que.	77,000	1986
Makin Pulp & Paper[3]	Britannia Beach, B.C.	58,000	1987
Repap Enterprises	Newcastle, N.B.	200,000–260,000	1989

1. Div. of James River Corp.
2. New coater to use paper from existing paper machines.
3. Combination of coated and uncoated free-sheet.

Sources: *Pulp & Paper Week, Pulp & Paper Project Report.*

TRENDS IN LWC PUBLICATION GRADES

Magazines remain the most important market for LWC paper (usually considered under 40-lb basis weight, although some companies include 40-lb), and magazine demand trends generally, though not always, dictate LWC supply trends. Indeed, the coated paper glut in late 1986, which continued into 1987, was partially attributed to requests from publishers earlier in the decade that papermakers add capacity. Many of them signed agreements to purchase the new tonnage; however, falling advertising pages in 1985, 1986, and early 1987 actually caused a slowdown in demand from publishers.

Coated groundwood is the single most important grade used by magazines in the U.S; about three quarters of all paper consumed by domestic magazines is of this type. Coated groundwood paper manufacturers in North America look to magazines to purchase nearly 60% of their production.

A survey by the Magazine Publishers Assn. suggested that total paper tonnage used by its members had increased 2.1% in 1986, and sources indicated that 1987's increase was near 5%. Magazine use of coated groundwood grades rose about 3.8% in 1986 and 4.3% in 1987, MPA reported.

U.S. COATED PAPER CAPACITY

(000 short tons)

	Coated free-sheet	% change	Coated groundwood*	% change
1990p	3,880	3.0%	4,509	3.8%
1989p	3,767	11.0	4,344	2.2
1988p	3,393	4.8	4,251	2.9
1987	3,237	10.0	4,132	8.8
1986	2,944	3.5	3,799	–0.5
1985	2,845	1.9	3,820	1.4
1984	2,791	12.9	3,766	6.9
1983	2,473	8.9	3,522	6.3
1982	2,271	1.2	3,312	8.7
1981	2,225	0.2	3,047	10.3
1980	2,222	0.4	2,762	10.1
1979	2,214	5.6	2,511	2.5
1978	2,096	5.4	2,450	1.7
1977	1,989	4.5	2,408	12.2
1976	1,903	–1.5	2,299	8.1
1975	1,938	—	2,127	–4.8
1974			4,075	0.7
1973			4,045	4.6
1972			3,866	0.2
1971			3,778	0.2
1970			3,700	–0.1
1969			3,732	—

* Includes all coated paper capacity until 1975.
p = Preliminary.

Source: American Paper Institute.

Coated free-sheet usage by those publishers was off 4.5% in 1986, but it may have grown, paradoxically, to 8.5% in 1987. Uncoated groundwood lost in both years, dropping 1.3% in 1986 and falling another 2.9% in 1987. Both these grade segments are relatively minor factors in overall demand figures; combined, they account for less than a quarter of the paper used by the major publishers.

Magazine publishers are continuously searching for ways to reduce publishing costs, especially because of increases in mailing charges. Average postal rates for second-class mail rose a cumulative 229% between 1970 and 1983, even though they dropped 7.6% in 1985 and remained level through the first half of 1987. These increased delivery costs forced publishers to seek ways to cut expenses. Paper basis weight became a prime candidate.

The same factors affect the direct-mail catalog business. A postal rate hike in 1985 increased the cost of bulk mail by about 13.6%. In April 1988, the Board of Governors of the U.S. Postal Service approved postage rate increases of 25% on third-class mail, such as bulk mail, and 18% on second-class items, such as newspapers and magazines. Fourth class (parcel post) increased 15%, and first class went up about 14%.

At the time, a converter said the Postal Service had predicted a decline of 7.0 billion units going through the mail, which would cause a 10% drop in orders for papers used in third-class mail. Demand for paper for first-class business envelopes also would decline, but by a lesser amount, he said.

Some mass mailers will look to other means for getting their message across, including increased use of newspaper inserts and electronic media, according to Randy Shingler, executive vice president of the Envelope Manufacturers Assn. of America. The increases "will make electronic media more attractive than they've been recently," he said.

Magazine publishers may not use the postal increase to downgrade. "It's going to cost us more money," said one major magazine publisher, "but we have an obligation to our readers and advertisers to retain our quality," which means the company will not downgrade its paper but may drop basis weights in some cases. This publisher and others already took most of the postal hike into account for current operating budgets and raised their advertising rates in January 1988. Causing more anguish are the three consecutive price increases on LWC papers that have been implemented since mid-1987.

James L. Hutchison, vice president, paper group, at the American Paper Institute, said that the postal rate hike is not likely to have a long-term negative impact on paper use. The short-term effect will be to reduce third-class mailings for the next three or four quarters, although mailers eventually will absorb the postal rate hike, he said.

Third class often is used for bulk advertising and catalogs. Among high-volume magazines such as newsweeklies and major monthlies, preferences have been slowly shifting to lighter-weight coated papers since the 1970s. Almost 100 of the nation's major publishers have moved away from 40-lb paper at about 3%/year this decade, a trend continuing into the late 1980s. Estimates placed paper below 36 lb at about 10% of all coated No. 5 shipments in 1970, rising to 20% in 1976 and probably to over 25% in 1981. Paper between 36 lb and 40 lb fell from 32% in 1970 to 13% in 1976 and possibly to 10% by 1986. Those trends have continued, with 34-lb paper becoming the major lightweight grade and papers as light as 32 lb and 30 lb appearing in the market as well.

The trend toward lower basis weights is being followed by mass-market magazine publishers all across the board. While some moved away from 40-lb paper to 34-lb stock, publishers that previously printed on 50-lb paper have shifted down to 45 lb or 40 lb. In apparent contradiction to that trend, specialty magazines targeted to particular—often wealthier—audiences are increasing their share of the magazine market. These periodicals typically are printed on higher-quality, heavier-weight paper, often No. 3 coated.

Still, not all publishers buy the argument in favor of reducing basis weight because they print paper on an area basis but buy it on a weight basis. Thus, they pay a premium for lightweight paper. In addition, press runability falls as basis weight declines, resulting in greater paper losses.

A paper shortage earlier in the 1980s encouraged some customers to print inserts and other materials on supercalendered (SC) uncoated groundwood or rotonews. As a result, K-Mart Corp., Sears Roebuck & Co., and others used rotonews and SC papers more liberally. In late 1986 and early 1987, however, customers produced better quality literature for the same cost, or saved even more money by staying with the lower grades. Still others moved from coated groundwoods to No. 4 coated free-sheet grades when those prices became weaker in 1987. The situation changed in mid-1987, and shortages again caused price increases and some grade switching, though competing grades also were scarce.

LWC mills have emphasized technological efforts in maintaining surface properties and runability while cutting weight. Runability and printing characteristics such as ink holdout and ink gloss are more important to publishers than is opacity. These needs make the mechanical integrity of the sheet (i.e., flawlessness) more important.

In order to drop basis weights below 36 lb, mills must reduce the weight of both the basestock and the coating. Different coating mixtures and new lightweight chemical compositions allow some mills to make the reductions in coat weight—going to a 6-lb coating formulation, for example, from a 10-lb or more formulation. Other mills reduce the weight of the basestock by a greater percentage. Some mills can use a lighter-weight basesheet than others can. Surface smoothness is the deciding factor.

Kraft fiber can be added to lend tearing strength for reduction of breaks, to carry flaws, and to maintain paper machine and press runability. Groundwood fiber offers reduced cost, maintains opacity and surface smoothness, and supplies much of the sheet's fiber content.

Thermomechanical pulp (TMP) and chemi-thermomechanical pulp (CTMP) have received wide industry attention as alternatives to stone groundwood pulp. The TMP process produces fibers that are better separated than groundwood pulp fibers and that have the added benefit of retaining much of their original length. Thus, TMP fibers hold together better, adding strength to the finished paper.

MAJOR U.S. COATED GROUNDWOOD PRODUCERS

(1988 estimated capacities)

	Annual capacity (000 tons)	Capacity share (%)
1. Champion International	689	16.2%
2. International Paper[1]	630	14.8
3. Consolidated Papers[1]	550	12.9
4. Bowater	325	7.6
5. Boise Cascade[1]	320	7.5
6. James River[1]	295	6.9
7. Blandin Paper	285	6.7
8. Mead	270	6.4
9. Pentair Industries[2]	220	5.2
10. Midtec[3]	193	4.5

U.S. capacity (1988): 4.251 million tons.
Capacity share of top five companies: 59.1%.
Capacity share of top ten companies: 88.8%.

[1] *Pulp & Paper* estimate.
[2] Niagara, Wis.
[3] Kimberly, Wis.

MAJOR U.S. COATED FREE-SHEET PRODUCERS

(1988 estimated capacities)

	Annual capacity (000 tons)	Capacity share (%)
1. Scott Paper[1]	900	26.5%
2. Westvaco	500	14.7
3. Mead	395	11.6
4. Simpson[2]	290	8.5
5. Champion International[2]	285	8.4
6. Consolidated[2]	270	8.0
7. Potlatch[3]	270	8.0
8. Midtec[4]	177	5.2
9. Newton Falls	100	2.9
10. Boise Cascade	75	2.2

U.S. capacity (1988): 3.393 million tons.
Capacity share of top five companies: 69.7%.
Capacity share of top ten companies: 96.0%.

[1] S.D. Warren Div.
[2] *Pulp & Paper* estimate.
[3] Northwest Div.
[4] Div. of Repap Enterprises.

CTMP has a higher tensile strength—about the same as chemi-mechanical pulp—than TMP, plus a higher tear factor. CTMP paper normally has a lighter color than TMP.

Various industry observers believe that International Paper chose a variation of CTMP for its new coated groundwood mill in Pine Bluff, Ark. That mill uses "chemically enhanced groundwood" for its basesheet, although the process reportedly encountered some initial production problems. If papermakers had their way, most of them would use titanium dioxide as a coating material, especially for LWC, because of its superior opacity. But recent shortages have caused already stiff prices to jump higher. Thus, kaolin clays remained the most widely used coating by volume, about four million tons used in 1987 compared with 200,000 tons of titanium dioxide. When titanium dioxide is used, the balance of coating material content is specialized clay, such as delaminated grades. These are calcium carbonate, hydrated alumina, plastic pigment, talc, and zinc oxide.

MARKETS FOR COATED PAPERS

Close to 40% of all C2S paper production in 1987 was used for magazines, the largest market for coated paper. That percentage climbed to as high as 52% during the past decade. The high was in 1983, a swing of more than 475,000 tpy. One estimate indicated that of the more than 2.7 million tons of paper used by magazines in 1987, nearly 2.6 million tons were coated, with 5.0% of paper shipments to magazines coming from Nos. 1-3, 18.6% from No. 4, and 70% from No. 5. The balance represented C1S and uncoated paper.

The trend in the magazine publishing industry is toward lighter basis weights in publication-grade paper. In 1987 and 1988, papers with basis weights of 34 lb and 32 lb and below were expected to increase in usage by 1% or 2%.

CANADIAN FINE PAPER PRODUCERS ESTIMATED ANNUAL CAPACITY

(000 short tons)

	Total fine paper (coated & uncoated)[1]	Coated
Domtar Inc.	500	—
Fraser Inc.[2]	276	—
Kruger Inc.	—	209
Rolland Inc.	152	—
Eddy Paper Co.	151	—
Abitibi-Price Inc.	—	160
Island Paper Mills[3]	123	—
Great Lakes Forest Products[4]	121	—

1. Does not include uncoated groundwood paper grades.
2. Does not include half-ownership in Island Paper Mills.
3. Owned 50% by MacMillan Bloedel and 50% by Fraser.
4. In process of merging with CIP.

Coated paper demand from catalog publishers also was on the rise. Catalog publishers purchased more than 1.6 million tons of coated paper in 1985 (the last date for which information is available)—9% more than in the previous year. Nos. 4 and 5 are the fastest growing segments of the coated catalog paper market, and No. 5, with about 800,000 tons in 1985, was the biggest segment at a healthy 12.5% growth rate.

The catalog business has grown rapidly, with a 17.6% jump in just one year, 1985 over 1984. That translated into 10 billion pieces from about 6,500 publishers. Demand for coated papers for catalogs could reach over two million tons by 1990. Demand for catalogs increased 56% in 1986 from 1985, according to the Direct Marketing Assn.

Slightly under 300,000 tpy of coated paper was going into the book market from 1984 through 1987, about 1%

U.S. PRICES FOR COATED PUBLICATION PAPER

($/short ton)

Year	No. 1 70-lb sheets	No.3 60-lb rolls	No. 5 34-lb rolls (roto)
1988[1]	$1,450	$1,060	$940
1987			
4Q	1,440-1,460	1,060	890
3Q	(1,400)/1,415	1,022	847
2Q	(1,390)/1,415	(945)/1,020	(760)/787
1Q	1,415*	(945)/1,020	(760)/787
1986			
4Q	1,375	980	860*
3Q	1,375	980	860*
2Q	1,375	980	888*
1Q	1,375	980	902*
1985			
4Q	1,375	980*	931*
3Q	1,375	980*	931*
2Q	1,375	980	931
1Q	1,375	980	931
1984	1,318	921	860
1983	1,250	830	782
1982	1,200	798	760
1981	1,130	798	760
1980	1,038	750	735
1979	970	690	671
1978	893	621	573/590
1977	n.a.	600	520/545
1976	n.a.	540	460
1975	n.a.	486	399
1974	n.a.	475	400
1973	n.a.	n.a.	285

n.a. = Not available.
1. End of second quarter.

Sources: *Pulp & Paper Week*, *Pulp & Paper Pricebook*.

to 2.8% annually. Total shipments of paper to book publishers dropped slightly in 1987, but future demand may grow as much as 5%/year through 1990.

The other major market is commercial printing, with 2.9 million tons of coated paper going into that sector in 1987. Of the coated-paper segment of commercial printing, the market share split by grade was as follows: No. 1, about 12.9%; No. 2, 10.0%; No. 3, 27.6%; No. 4, 23.4%; No. 5, 24.3%; and C1S, 1.6%. Commercial printing uses about 42.1% of all coated-paper production.

Included in that market are flyers and inserts. It is estimated that preprinted newspaper inserts are growing at a rate of 5% to 7%/year, with coated paper usage for inserts to rise from about 400,000 tons in 1986 to 600,000 in each of the four following years.

Soft markets and end-user demand have in recent years led some paper companies to increase the coated groundwood share of the commercial printing market through coating variations that improve brightness from a typical coated groundwood range of about 70 to 72 (GE) to a range of 78 to 82.

The other coated-paper segment—C1S—totaled around 400,000 tpy, of which 80% went toward labels, representing 91.4% of all label paper. Coated papers for label and wrap manufacturers and for other converted products probably will rise 5%/year through the end of the decade.

Specialty-paper segments represent a small but increasingly important source of income for coated paper producers and, in fact, may help some older paper mills survive the onslaught in commodity printing and writing papers from big, new mills (see chapter on packaging and industrial converting papers).

OUTLOOK FOR COATED PAPERS

For the balance of the 1980s, coated paper demand probably will continue to grow above real GNP. The superior printing qualities of coated paper, as opposed to either uncoated free-sheet or uncoated groundwood, has drawn many publishers and printers to coated papers.

Analysts predicted that coated free-sheet operating rates would remain a healthy 94% or better in 1988. Output of coated free-sheet from U.S. mills rose almost 11% in 1987 from 1986, but it was expected to jump somewhat higher than the 4.8% rise in capacity in 1988.

Demand for coated free-sheet premium grades was rising, due in large part to demand from printers of annual reports. Commercial printing and upscale consumer magazines also were expected to help increase consumption by 4% to 5% in 1988.

Nos. 1 and 2 grew at an average annual rate of 7.9% from 1979 to 1984. The growth rate will average about 3.1% annually in the 1985 to 1990 period, according to

COATED PAPER SHIPMENTS TO MAGAZINE PUBLISHERS (1978-87)

(000 short tons)

Year	Coated two-sides paper	C2S Nos. 1-4	C2S No. 5	All grades*	Coated paper imports
1987	2,569	645	1,925	2,570	614
1986	2,428	527	1,901	2,432	501
1985	2,275	448	1,827	2,299	496
1984	2,397	498	1,899	2,428	428
1983	2,290	470	1,820	2,450	162
1982	2,010	425	1,585	2,130	69
1981	2,009	408	1,601	2,185	36
1980	1,969	405	1,564	2,125	115
1979	1,838	400	1,438	2,017	189
1978	1,902	365	1,537	2,054	214

*Includes coated one-side.

Source: *Pulp & Paper* estimates.

PAPER SHIPMENTS TO COMMERCIAL PRINTERS

(000 short tons)

Year	Coated two-sides paper	C2S Nos. 1-4	C2S No. 5	Uncoated free-sheet	Uncoated groundwood	Total
1987	2,842	2,140	702	2,735	177	5,754
1986	2,469	1,900	569	2,570	202	5,241
1985	2,240	1,760	480	2,430	250	4,920
1984	2,400	1,830	570	2,350	280	5,030
1983	2,075	1,535	540	2,165	245	4,485
1981	1,720	1,300	420	1,950	175	3,845
1980	1,605	1,200	405	2,000	220	3,825

Source: *Pulp & Paper* estimates.

S.D. Warren Div. of Scott Paper Co. No. 3 grew 4.2%/year from 1979 through 1984, and it will slow to 2.6% from 1985 to 1990.

No. 4 coated also benefited from impressive growth between 1979 and 1984, advancing at 7.8% annually. The rate was expected to drop to 5.4% in the late 1980s. No. 5's strong 8.5% annual growth in the first half of this decade slowed to 4.6% in the second.

Small discounts plagued coated free-sheet grades throughout most of 1986 and the first half of 1987, but prices began rising steadily through 1988.

The $1,375/ton list price for No. 1, +70-lb in sheets took hold at the beginning of 1985, with discounts to and below $1,325. But price hikes eventually held, bringing No. 1 to between $1,390 to $1,440/ton by the second half of 1988. The increases also affected No. 3 on rolls of 60-lb, which increased from $980/ton list to $1,040 during that same period. At least one additional hike was predicted for 1988.

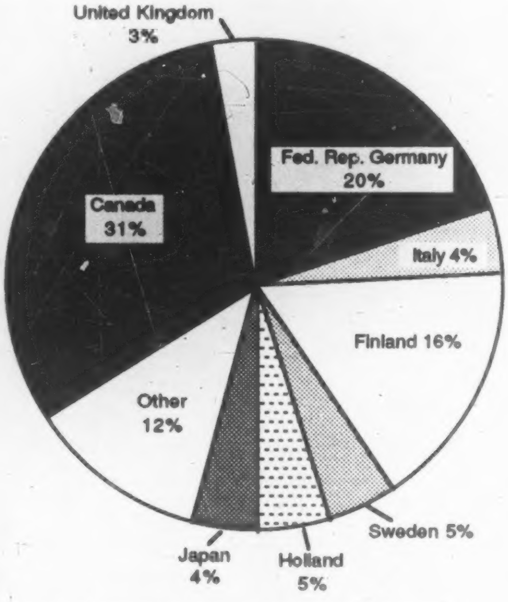
Shipments of coated groundwood grades rose nearly 9% in 1987 from 1986, following similarly strong growth in the two previous years. The major growth area was with commercial printers, who purchased 11% more paper than in 1986. Magazine orders rose as well, despite trouble falling advertising pages caused by higher rates and economic uncertainty. Other periodical publishers reduced their paper purchases by about the same amount. Book publishers received nearly the same tonnage of coated groundwood paper in 1986 and 1987.

Coated groundwood papermakers were expected to post operating rates above 95% in 1988, about the same as in 1987. Coated groundwood prices firmed up throughout 1987 as related grades, especially uncoated groundwood, also became tight. This came as a welcome change from late 1986, when fears of overcapacity caused prices to plunge. List prices were raised January 1, with additional hikes in 1988. The January 1 increase brought No. 5, 40-lb offset in rolls to $840/ton.

The following are historical pricing trends ($/short ton, year-end except 1988, which is first quarter, for 34-lb roto paper: 1981, $760; 1982, $760; 1983, $782; 1984, $890; 1985, $931; 1986, $860; $1987, 890; first-quarter 1988, $940.

The only new capacity due onstream in the near future is 200,000 tons of coated groundwood at Blandin Paper Co.'s Grand Rapids, Minn., mill. Another 200,000-plus metric tons was announced at Repap's Miramichi mill, and Weyerhaeuser reportedly is considering a second LWC

U.S. IMPORTS, 1987



Total 1987 Coated Paper Imports: 672,518 tons

Source: Dept. of Commerce

U.S. COATED PAPER EXPORT/IMPORT BALANCE

(000 short tons)

	Exports[1]	Imports[2]
1987	101	614
1986	78	501
1985	82	496
1984	86	428
1983	79	162
1982	81	69
1981	89	39
1980	92	115
1979	74	189
1978	74	214
1977	99	113[3]
1976	107	—
1975	123	—
1974	99	—
1973	80	—
1972	76	—
1971	76	—
1970	75	—
1969	70	—

1. Clay-coated printing and writing paper.
2. Coated and impregnated printing papers.
3. In previous years, coated paper imports were reported under another category.

Source: Bureau of the Census.

machine at Columbus, Miss. Between 600,000 and 800,000 tons of new coated groundwood papers will become available in the next few years from Europe and Scandinavia. Possibly more of a threat is new and higher-quality SC paper capacity, such as the Web-Sized Offset Paper (WSOP) from Abitibi-Price Inc.'s Kenogami mill and SC-A paper from Lake Superior Paper Industries' new mill in Duluth, Minn., which uses technology from Haindl Papier GmbH of Fed Rep. Germany.

The industry recently recognized that coated paper is threatened by SC paper, rather than electronic surrogates of coated paper end uses. The premium SC papers usually are offered for sale at $100/ton less than LWC. Other threats come from high-brightness uncoated groundwoods and the new Scandinavian lightly pigmented grades that fall between SC and No. 5 coated groundwood.

Demand for coated papers in the 1990s is expected to be healthy, jumping to somewhere near 10 million tons in the U.S. alone. Canadian demand will reach several million tons. This means that imports to the U.S. also will rise, with Scandinavia, Fed. Rep. Germany, and Canada being the major suppliers. Canada will also see imports from Europe, Scandinavia, and the U.S.

Offshore mills were able to make inroads in North America during the paper shortage of the 1970s, and they are likely to try to hold on to most of their market share, even though coated papers will be more abundant domestically in the 1980s and 1990s. Importers will match North American producers on prices, and they will introduce value-added and in-between products, such as the Scandinavian lightly pigmented grades. The Scandinavians, Europeans, and Japanese also will focus on providing basestock for special coated office papers such as thermal printing/transfer paper, and for specialty products such as label release papers and greaseproof food and beverage papers. Offshore producers also will compete in North America by buying into production facilities, such as Kanzaki Paper Manufacturing Co. Ltd. of Japan did with the Ludlow Corp.'s Specialty Papers Div. converting plant in Ware, Mass., in late 1986.

The small No. 1 market will post the strongest growth, 70% to 80% in the next 10 years. Demand for Nos. 2-4 will advance by half or better, while No. 5 papers will move ahead by about one-third. The future of annual reports, along with commercially printed products, will determine the true growth rate of No. 1 grade. In 1987 the U.S. Securities & Exchange Commission announced that companies were not required to produce the high-quality, glossy annual reports so familiar to shareholders, but most companies did not seem anxious to rid themselves of these self-promotional vehicles.

Producers of No. 2 grade will closely watch what happens with so-called durable goods such as appliances and automobiles, as many of these products' promotional brochures are printed on this grade.

No. 3 grade probably will make the strongest advances because of growth in higher-quality catalogs and commercial printing.

The fortunes of No. 4 will depend on the success of mid-quality magazines in attracting readers and advertisers, along with the acceptance of upscale catalogs. For example, the catalog of trendy Sharper Image uses an 80-lb No. 4 free-sheet—Panaprint Web from Champion International—for its cover and 45-lb No. 4 groundwood—Northcote Web from Mead Fine Paper Div.—for its text pages.

No. 5 paper has not suffered from relatively stagnant magazine markets. In addition, the 1987 technology forecast by the Graphic Arts Technical Foundation predicted that advertising inserts and catalogs would grow at a rate of 6% to 10% annually, benefiting this and other coated grades.

Much of the expected 22% increase in coated groundwood capacity from 1985 to 1989 already is in place, although not operating up to full speed. For coated free-sheet, the 22% rise in capacity is spread more evenly over those five years.

UNCOATED FREE-SHEET

GRADE STRUCTURE

Uncoated printing and writing papers are used for a variety of end uses, including but not limited to personal stationery, carbonless basestock for business forms, book paper, and business papers. Despite the diversity of end uses, all uncoated papers are made primarily from chemical pulps (sulfate, sulfite, soda, cotton linters, or vegetable fiber). Only a few contain any mechanical pulp at all, even though paper with up to 10% mechanical pulp still is classified as uncoated free-sheet.

Typically, there are four subgroupings within the uncoated printing/writing paper sector, based on end use: publishing, commercial printing, office, and writing paper. An additional smaller subgrouping includes products such as cigarette papers and carbonizing tissue.

Offset paper is the largest sector of uncoated free-sheet papers in the U.S. market, when discussed in terms of tonnage. This grade represented approximately 25% of all shipments in 1987, while bond/mimeo/duplicating/xerographic represented 25%; forms bond, 20%; envelope, 11%; tablet, 4%; and miscellaneous printing and writing papers, 15%.

INDUSTRY STRUCTURE

Most U.S. uncoated free-sheet mills are located in the Northeast and upper Midwest, although in the last 20 years the South has seen a strong surge of new capacity.

Between 1986 and 1990, southern capacity is expected to grow about 23%, accounting for 41% of the nation's free-sheet capacity in 1990, up from 38% in 1986. On the other hand, the Northeast/Midwest will decline from higher than 50% in 1986 to just above 45% in 1990.

Of four major projects coming online between 1986 and 1988, three are in the South, and one is in the Northwest. New capacity onstream by the end of 1986 included: Georgia-Pacific Corp., 290,000 tpy at Port Hudson, La.; Hammermill Papers Group of International Paper Co., 185,000 at the Riverdale mill in Selma, Ala.; and Champion International Corp.'s 260,000 tpy conversion from unbleached kraft paper at Pensacola, Fla. In addition, Boise Cascade Corp. will convert and rebuild its 110,000-tpy machine in Wallula, Wash., by late 1988 and add a new 300,000-tpy machine at International Falls, Minn. Startup is scheduled for late 1990.

Another trend in U.S. uncoated free-sheet paper production is the move toward larger machines. The number of machines producing over 125,000 tpy rose from 7.5% of total industry capacity in 1975 to more than 20% in 1986, while units of 75,000 tpy and below fell from 72.5% of

U.S. STATISTICS FOR UNCOATED PRINTING/WRITING PAPERS*

	1988e	1987	1986	1985
Production,[1] 000 tons	11,049	10,983	10,410	9,750
Capacity, 000 tons	11,780	11,520	11,023	10,515
Utilization rate, %	93.8	95.3	94.4	92.7
Imports, 000 tons	447	417	454	365
Exports, 000 tons	84	68	50	65
Apparent U.S. consumption				
000 tons	11,412	11,332	11,326	10,050
lb/capita	93.04	93.23	89.80	83.93
000 tons/$ billion real GNP (1982)	2.90	2.97	3.05	2.79

* All tons are short tons.
e = Estimate.
1. American Paper Institute data for shipments.

Source: *Pulp & Paper*.

industry capacity in 1975 to 46% in 1986. Besides Boise's proposed machine at International Falls, Minn., the trend toward larger machines is exemplified by Georgia Pacific's machine at Port Hudson, La.

In addition, more and more mills are reducing their reliance on purchased pulp through integration of pulp and papermaking operations. Some companies have built new pulp mills with enough room left over to build one or more paper machines. The percentage of U.S. industry capacity represented by integrated mills—mills with active onsite pulpmaking capacity—rose from 64.8% in 1976 to 76% in 1986, according to American Paper Institute figures. The same figure applies to uncoated free-sheet mills.

Unlike the new mills and machines in the South, mills in the Northeast and Midwest tend to have much less capacity. They are also older, usually nonintegrated, and equipped with paper machines of 150-in.-trim or less. Although commodity grades might be expensive to run on these machines, companies have found fairly exclusive niches by producing specialty grades that larger mills could not make economically, and they have emphasized smaller runs in order to serve the needs of a wide variety of customers. The papers made are sold for many times the amount of commodity grades, often exceeding them by hundreds or thousands of percent.

In order to protect mills from some of the penalties of nonintegration, especially the volatility of market pulp prices in times of tight pulp supply, some of these mills have experimented with buying deinked pulp or pulp substitutes (white shavings, etc.). An accompanying table shows how the price of pulp (literally, the price of being nonintegrated) can affect such mills. When taken from an historical perspective, the cost of pulp represented only 33.9% of selling price in 1970, whereas in 1980, it had risen to 56.0% in the U.S. Things got better in early 1982 when, with hardwood pulp available at deep discounts and the list price for pulp unchanged from 18 months earlier, pulp represented only 49.7% of the paper grade's selling price, assuming no pulp discount, and a still lower percentage if discounts were applied. The pulp cost advantage of an integrated mill, $100 in 1980, had probably declined as the pulp market slid.

But, starting in mid-1984, pulp prices began rising again and uncoated free-sheet was plagued by continued discounting, especially in offset grades. The cost of pulp climbed back up to 53.5% of the paper grade's selling price. The ratio of selling prices dropped back down in 1985, but it began another climb on the coattails of strong pulp price increases in 1986 and 1987.

The reason nonintegrated mills tend to have higher fuel costs is that they cannot benefit from wastewood to supply biomass boilers or from byproduct fuel from kraft liquor. The most positive news is that, being closer to major markets in the North, they may have lower transportation costs.

Southern mills that are producing commodity-type grades such as offset paper, forms bond, and reprographic paper are using twin-wire or large fourdrinier paper

UNCOATED FREE-SHEET PAPERS CLASSIFIED BY END USE

Printing/publication
- Offset (book)[1]
- Lightweight printing[1]
- Envelope[1]
- Tablet[1]
- Cover & text[1]

Writing
- Bond
- Cotton-fiber[2]

Bristols[2]

Business
- Forms bond[1]
- Copy & reprographic[1]
- Carbonless[1]
- Mimeograph[1]
- Duplicating[1]
- Other

Thin papers
- Carbonizing
- Cigarette
- Condenser

1. Conforms to American Paper Institute classification of free-sheet.
2. This grade discussed in separate section.

U.S. PRODUCTION AND CAPACITY OF UNCOATED FREE-SHEET PAPERS*

(000 short tons)

	Production[1]	% change	Capacity[2]	% change
1990p	—	—	12,543	2.9%
1989p	—	—	12,190	3.5
1988p	—	—	11,780	2.3
1987	10,983	5.5	11,520	4.5
1986	10,410	7.4	11,023	4.8
1985	9,690	5.9	10,515	4.5
1984	9,152	4.9	10,058	7.5
1983	8,725	11.7	9,354	3.5
1982	7,809	–0.1	9,039	2.4
1981	7,867	–0.1	8,828	2.1
1980	7,984	4.6	8,645	6.8
1979	7,655	6.3	8,095	3.1
1978	7,198	2.3	7,847	5.1
1977	7,036	9.4	7,465	2.0
1976	6,430	13.9	7,319	1.9
1975	5,644	–18.6	7,180	1.9
1974	6,934	0.0	7,046	7.7
1973	6,933	9.4	6,541	5.5
1972	6,339	18.5	6,198	7.2
1971	5,349	3.3	5,780	1.3
1970	5,177	–0.8	5,702	0.3
1969	5,222	—	5,681	—
Average 1970-87		4.6%		4.0%

p = Preliminary.
* Excluding cotton fiber, bristol, and thin paper.
1. Source: Bureau of the Census.
2. Source: American Paper Institute.

machines. These mills use a blend of hardwood and softwood pulps, with hardwood fibers providing desired bulk and printing characteristics and softwood fibers offering strength properties for improved paper machine and printing press runability.

Another changing aspect of the uncoated free-sheet market is the entry of Canadian mills. Domtar Inc. brought online one 160,000-metric-tpy free-sheet machine at the end of 1987 and plans to start up another of the same size in 1989.

The move toward alkaline papermaking is yet another major development. Several older mills, particularly the white papers mills of International Paper and its Hammermill subsidiary, have converted or are converting to the alkaline process, while some new mills, particularly Willamette Industries' new machine in Bennettsville, S.C., also will use alkaline-based furnish for their uncoated papers.

Increased interest in the alkaline process is due primarily to rising costs for fiber and for fillers such as titanium oxide and calcine clay. In addition, alkaline sheets are stronger than acid-based papers, and the use of precipitated calcium carbonate helps cut down fiber use.

An important issue to libraries is the permanence of alkaline book papers compared to acid-based stocks. The American Library Assn. Council and the National Information Standards Organization (NISO) are urging publishers to print on alkaline-based papers. Both groups worry about deterioration of library collections, according to a published report.

OUTLOOK

Producers of uncoated free-sheet papers have experienced a steady rise in production for most of the 1980s. The first major jump—11.7%—came in 1983, after 0.1% drops in both 1982 and 1981, according to API figures. Shipments rose 4.9% in 1984, about 5.9% in 1985, almost 7.4% in 1986, and 5.5% in 1987.

High operating rates are continuing in the latter half of the decade. Back in 1981, the operating rate for uncoated free-sheet mills was 89.1% in the U.S., falling to 86.4% in 1982. But then the market began its strengthening trend, staying above 90%. Operating rates were pegged at 93.3% in 1983, 91.0% in 1984, 92.2% in 1985, 94.4% in 1986, and 95.3% in 1987. Various analysts predict a 1988 utilization rate of between 94% and 99%, depending on various factors.

These estimates match predictions by industry executives who expect generally good times in the free-sheet sector. Even though early 1987 began with somewhat weakened pricing because of perceived overcapacity, demand increased through the year and into the first quarter of 1988 based on need and fear of future price increases. Between 1986 and 1990 the U.S. industry plans to add more than 1.5 million tons of capacity.

Forms bond and copy paper are likely to continue to benefit from current information processing and office printing trends. Forms bond shipments were up almost 12% in 1987 from 1985, continuing a double-digit trend begun earlier in the decade. In fact, API reported that the number of copy machines rose 15% a year between 1981 and 1986. The number of electronic printers also grew substantially.

On the other hand, both forms bond and cut-size paper, along with offset printing papers, were subject to occasional discounting in the first quarter of 1987. Much of the problem came from expected overcapacity, although imports added their impact prior to 1987. Dept. of Commerce figures show a jump of almost 26% in uncoated free-sheet imports into the U.S. in 1986, hitting over 476,000 tons, up from 379,000 tons in 1985. This continued the rise from previous years, but by year-end imports had tapered off, and imports lost ground by about

ESTIMATED 1988 ANNUAL CAPACITIES FOR MAJOR U.S. COMPANIES FOR UNCOATED PRINTING/WRITING GRADES

(000 short tons)

1. International Paper Co.	1,900
2. Champion International Corp.	1,200
3. Boise Cascade Corp.	910
4. Georgia-Pacific Corp.	900
5. James River Corp.	850
6. Great Northern Nekoosa Corp.	830
7. Union Camp Corp.	750
8. Weyerhaeuser Co.	620
9. Mead Corp.	475
10. P.H. Glatfelter Co.	400
Total[1]	11,780

1. Includes all other companies.

RISE OF ROLLSTOCK vs SHEET-FED PAPER IN U.S. UNCOATED OFFSET FREE-SHEET PAPER INDUSTRY

(% of total uncoated free-sheet shipments)

Year	Rolls	Sheets
1986	68%	32%
1983	65	35
1980	61	39
1975	53	47
1970	45	55
1965	35	65

Source: *Pulp & Paper* estimates.

8% in 1987. Importers had to deal with the weakened U.S. dollar relative to foreign currencies, which made imported paper less attractive to U.S. buyers. Canada was the major exporter in 1987, shipping over 200,000 tons of uncoated free-sheet papers into the U.S. The Scandinavian countries followed with more than 100,000 tons. Cash-strapped Mexico and Brazil also took advantage of tight U.S. markets to ship more than 40,000 tons each of uncoated free-sheet papers.

In addition, strong late-1987 demand pushed up new U.S. orders by 6.0% in 1987 from 1986, with mill allocation systems reflected in the 26.6% increase in unfilled orders. Shipments themselves increased 5.5%.

The slightly softening market at the beginning of 1987 was characterized by increases in producer inventories. Some market observers believed that mills would have to take some downtime during the year to make up for this softness. Inventories also were building up at merchant houses. By mid-year, however, markets had improved and rising pulp prices encouraged producers to begin the series of price increases that by April 1988 brought list prices up about 10% from the same time a year earlier, and the new list was almost 30% higher than the transaction price in early 1987.

OFFSET PAPERS

It is generally accepted that offset papers are part of the family of book papers, which can include tablet and envelope paper as well as offset. All of these grades are used for printing and graphic arts purposes, or they can be readily produced on the same machines as printing papers. Properties that distinguish one from another include surface finish, opacity, brightness, and bulk.

Despite the categorization as book paper, some offset paper is shipped to customers other than book publishers. In 1987, slightly more than 2.7 million tons of uncoated offset paper were produced, while total uncoated free-sheet shipments to book publishers hit only 560,000 tons. Additionally, not all paper used to print books is uncoated free-sheet, although the percentage is growing moderately. Uncoated free-sheet represented 60% of the 930,000 tons of paper shipped to book publishers in 1987, while uncoated groundwood represented 7.5%, and the coated grades represented another 32% in the U.S, according to analysts.

Actual consumption of uncoated free-sheet paper for books rose a dramatic 25.2% from 1982 to 1986, slightly higher than the 24.9% gain made by coated papers and in strong contrast to the small uncoated groundwood book papers market, which fell 15.8% during those years. However, uncoated free-sheet experienced a small 1.7% decline from 1986 to 1987, while coated gained 1% and uncoated groundwood almost 2.5%.

Shipments to commercial printers of offset and other uncoated free-sheet paper gained more than 8% in 1987 from a year earlier. This compares with coated, which gained more than 15%, and uncoated groundwood, which lost 14%.

Offset papers are sold either in rolls or in sheets (cut or folio sizes), and in 1986 rolls represented about 67% of all offset paper shipments.

Paper roll diameter and width must be standardized to meet the needs of printers. For stock roll grades, typical diameters are 32-in. and 40-in. Standard widths are 11-, 17-, 22-, and 35-in. If unstocked sizes are ordered, buyers usually pay a trim penalty.

Offset and other uncoated book papers are designed to run on high-speed offset presses, with the sheet surface-sized externally at a size press on the paper machine to prepare the surface for the slight wetness inherent in offset printing. A high degree of resistance to picking is also essential.

The various levels of opacity are produced by using titanium dioxide and other fillers. A range of qualities and prices is guaranteed by the wide variation in furnish, filler, and brightness available. Opacified offset paper also is desired in many cases because it has a slightly higher brightness and 2% to 3% higher opacity rating than standard offset book paper. Mills typically make a number of grades to meet the requirements of specific printing qualities and prices, thus creating variances for offset paper specifications. Properties typical for a No. 1-type offset sheet are listed in this section.

The use of recycled fiber or mechanical pulp in the furnish allows mills to offer lower-priced offset paper that retains relatively high opacity levels but offers a lower brightness rating. Additional variations among uncoated book papers are in bulk and sheet surface, with bulk being

FIBER COSTS FOR PRODUCING PRINTING GRADES AT NONINTEGRATED PAPER MILLS

Year	45 lb No. 3 offset sheets ($/short ton)	Northern hardwood kraft market pulp ($/short ton)	Ratio of selling prices (pulp/paper)
1987	$850	$522	0.614
1986	850	426	0.501
1985	800	327	0.409
1984	880	426	0.484
1983	840	381	0.453
1982	680	345	0.507
1981	878	445	0.507
1980	813	445	0.547
1979	717	393	0.548
1978	645	310	0.481
1977	555	250	0.450
1976	506	300	0.592
1975	484	335	0.692
1974	535	335	0.626
1973	457	225	0.492
1972	460	135	0.293
1971	455	135	0.296
1970	442	155	0.351

Note: All prices are year-end.

Source: *Pulp & Paper Pricebook 2.*

influenced by changes in basis weight as well as surface treatment. Common sheet surfaces include antique, eggshell, woven, and English.

LIGHTWEIGHT PRINTING GRADES

Lightweight printing grades are at the bottom end of the printing paper market in terms of basis weight, generally falling under the 40-lb (25 x 38 in., 500 sheets) range, and they are used for products ranging from Bibles to business forms. At least for forms bond, the very lightest basis weights are no longer favored as multi-part business forms give way to single-part forms that require stronger surfaces. In this area, the trend is away from basis weights under 18-lb to 18- and 20-lb papers, although 15-lb is still the most common.

For LWP grades, opacity should be at about 85% when the paper is over 26-lb basis weight. Heavy use of fillers helps accomplish this goal. Even lighter papers, ranging from 19-lb to 24-lb with opacities of 80% to 85%, are used for Bibles. Lightweight grades also are often used in products where page weight and bulk must be reduced for books or catalogs.

A variety of fibers is used to make LWP grades. These include chemical pulps, cotton fiber, flax straw, or a combination of these fibers. Production data for these grades are not available.

COVER AND TEXT PAPERS

Completely opposite from LWP papers, in terms of basis weight, are cover and text papers, which also are heavier in weight than offset papers and are used as covers for magazines, pamphlets, or paperback books, as well as for text pages in these publications. Cover and text papers can be as heavyweight as bristols, and they are sold in coated as well as uncoated grades. Cover stock can be embossed, coated, plastic-coated, or laminated with cloth.

NEW U.S. AND CANADIAN UNCOATED FREE-SHEET CAPACITY THROUGH 1992

Company, U.S.	**Location**	**Annual capacity (short tons)**	**Year**
Hammermill	Selma, Ala.	185,000	1986
Boise Cascade	Wallula, Wash.	40,000	1987
Champion International	Pensacola, Fla.	260,000	1987
Georgia-Pacific	Port Hudson, La.	290,000	1988
International Paper	various	200,000	1988-90
Kimberly-Clark	Whiting, Wis.	30,000	1989
Willamette	Bennettsville, S.C.	255,000	1990
Champion International[1]	Quinnesec, Mich.	(net) 58,000	1990-91
Great Northern	Ashdown, Ark.	80,000	1990
Boise Cascade	International Falls, Minn.	300,000	1990
Union Camp[2]	Eastover, S.C.	240,000	1992
Weyerhaeuser[2]	Columbus, Miss.	200,000	n.a.
Bowater	Calhoun, Tenn.	under study	n.a.
Company, Canada		**(metric tons)**	
Domtar[3]	Windsor, Que.	160,000	1987
Weyerhaeuser Canada	Prince Albert, Sask.	217,000	1988
Domtar	Windsor, Que.	160,000	1989
Great Lakes Forest Prod.	Dryden, Ont.	175,000	1989
Makin Pulp & Paper[4]	Britannia Beach, B.C.	135,000	1989

North American capacities, 1988
U.S.: 11.780 million short tpy
Canada: 915,000 metric tpy (estimated)

n.a. = Not available or not applicable.

[1] Initially will produce uncoated free-sheet, but designed for coated.

[2] Machine announced or discussed in principle, but plans not finalized.

[3] During 1986-9 period, Domtar will also be shutting down 97,000 tpy of old machines.

[4] Uncoated free-sheet and coated free-sheet.

Sources: *Pulp & Paper Week* estimates, American Paper Institute, Canadian Pulp & Paper Assn.

Cover and text papers provide higher quality at a higher price than offset paper. They are made in a variety of colors and finishes, and they are manufactured by the same companies that make offset and bond papers. Bleached board producers such as Federal Paper Board Co. Inc. and Temple-Eastex Inc. also make cover stock, especially coated cover.

Demand for these grades has grown by about 4.1%/year since 1980, reaching nearly 300,000 tons in 1987. There was, however, a brief decline in 1985 from 1984, mirroring movement by most other paper grades caused by a somewhat weakened economy.

Text papers, at over 190,000 tons, represented about 65% of this market in 1987.

BOND, MIMEOGRAPH, DUPLICATING AND COPY (BMDX) PAPERS

The BMDX grades are so similar in sheet properties and basis weights that many mills make the same paper for more than one end use, and mills commonly swing among grades depending on strength of demand for particular products. These grades are internally and surface-sized, since they are also commonly used for offset printing.

This family of papers generally is made from 100% chemical pulp, with opacity in the mid- to high-80s and brightness in the low- to mid-80s. Some cotton fiber may be used in high-quality bond papers. Cotton fiber papers are discussed in a separate chapter.

Bond papers. Mills have been able to tap the substantial bond and writing paper market, which has grown substantially in the last two decades. In 1960, annual shipments of bond and writing papers were pegged at 372,000 tons. By 1987, that figure had risen to 2.6 million tons, a healthy 10.5% increase from the year before, which also experienced an 11.4% rise from 1985.

Computer printers are expected to keep growing as a major market for cut-size bond and copy papers, although forms bond is likely to face some hurdles. Richard Norton, a researcher of office and copy papers for Dataquest Inc., predicts that overall U.S. demand for cut-size papers used for computer printers and copy machines will grow 20.6%, from 393,000 tons in 1986 to one million tons in 1991. Most of this paper will remain free-sheet.

Of cut-size paper end uses, page (laser) printers accounted for about 288,000 tons of paper in the U.S. in 1986, but demand will take about 786,000 tons by 1991—a 22.3% jump over the five years. Copier paper will post a much slower growth of just 4.0% over the five-year period, rising from slightly under 2.0 million tons in 1986 to almost 2.4 million tons in 1991. One avenue for improving market position in laser printer paper is for mills to produce product that can be printed on both sides. Another issue, as it is with copy machines, is the problem of curl, which can cause paper jams in both printers and copiers. Brightness also is moving up from the common 84 to 85 brightness to 86 to 88 brightness, according to Norton.

For noncut-size paper, use of stock continuous forms bond will grow at 7%/year, from 1.7 million tons in 1986 to 2.4 million tons in 1991, Norton said. Its sister paper, custom continuous forms, will show almost zero growth over the five years, staying at about 1.2 million tons used annually, Norton said. That is because computer printers now can produce forms from computer software programs. There also are so-called "intelligent copiers" that can produce forms right on the copy paper.

Nonimpact printers can use grades of paper other than cut-size bond, including fan-fold or rolled forms bond, recycled paper, preprinted forms, coated paper, labels, and even plastics.

The companies likely to retain or increase their market

BASIS WEIGHT AND BULK OF LWP PAPERS

Basis weight (lb, 25 x 38 in., 500 sheets)	Typical bulk (sheet/in.)
19* (28 g/m^2)	1,360
20* (30 g/m^2)	1,290
22* (33 g/m^2)	1,180
24* (36 g/m^2)	1,080
26 (38 g/m^2)	900/940
28 (41 g/m^2)	870/900
30 (44 g/m^2)	810/850
33 (49 g/m^2)	740/790
35 (52 g/m^2)	690/700
40 (59 g/m^2)	610/640

* Bible grades.

TYPICAL GRADE STRUCTURE FOR 100% FREE-SHEET OFFSET PAPERS

Basis weight (lb, 25 x 38 in., 500 sheets)	Grammage (g/m^2)	Opacity[1] (%)
35	52	82
40	59	86
45	62	87
50	74	89
55	81	91
60	89	90
70	104	92
80	118	94

[1] Government specifications for offset book printing paper; however, these are similar to those used by most companies for high-quality offset with brightness of 80-85.

U.S. PRODUCTION OF UNCOATED COVER AND TEXT PAPERS

(000 short tons)

Year	Cover	% change	Text	% change
1987	104	8.3%	190	5.6%
1986	96	10.3	180	5.9
1985	87	–3.3	170	2.9
1984	90	5.9	175	9.4
1983	85	13.3	160	18.5
1982	75	—	135	–6.9
1981	75	–1.3	145	–10.5
1980	76	–5.0	162	–0.5
1979	80	8.1	163	18.1
1978	74	8.8	138	13.1
1977	68	19.3	122	2.5
1976	57	32.6	119	5.3
1975	43	–17.3	113	–29.8
1974	52	–5.5	161	–2.4
1973	55	12.2	165	13.0
1972	49	14.0	146	5.8
1971	43	—	138	—

Source: *Pulp & Paper* estimates.

PRODUCERS OF LWP AND THIN PAPERS

Lightweight printing

Allied Paper Inc.
Jackson, Ala.

P.H. Glatfelter Co.
Neenah, Wis.

James River Co.
Kalamazoo, Mich.

Fletcher Paper Co.
Alpena, Mich.

Fraser Paper Ltd.
Madawaska, Maine

Kimberly-Clark Corp.
Lee, Mass.[1]
Neenah, Wis.

Ecusta Corp.[3]
Pisgah Forest, N.C.

Port Huron Paper Co.
Port Huron, Mich.

Sorg Paper Co.
Middletown, Ohio

Champion International Corp.[2]
Deferiet, N.Y.

Cigarette

Kimberly-Clark Corp.
Spotswood, N.J.[1]
Ancram, N.Y.[1]

Ecusta Corp.
Pisgah Forest, N.C.

1. Schweitzer Div.
2. Formerly St. Regis Paper Co.
3. Div. of P.H. Glatfelter Co.

positions for these papers are Boise Cascade, James River Corp., Hammermill Papers Div. of International Paper, and Mead Corp.

Mills make bond papers in a wide variety of qualities and prices to meet a range of office and stationery uses, with a typical No. 4 bond (20- to 24-lb) quoted at list price of $820 by the beginning of 1988. Prices in 1986 and 1987 declined from the peak levels of 1984, when list was up to $870/ton. Transaction prices slipped late in 1984 to just over $770/ton, about the average 1983 level. First-quarter 1987 transactions averaged a full $100 off the list, but generally strong paper markets helped prices rebound somewhat after mid-year, and the recovery continued into 1988, creating strong demand and shortages of paper, especially forms bond. In fact, some producers began using their forms bond machines to manufacture higher-value reprographic grades, causing even deeper cuts in deliveries of forms-grade papers.

Copy papers. Papermakers are now facing the challenge of producing low-cost, high-quality reprographic papers that run smoothly on new high-speed plain-paper copiers, which have become the dominant type of office and retail copier. In fact, the trend toward plain paper reprography has reduced coated-paper copiers to a few still being used in libraries, schools, drugstores, and other low-volume copy sites. Xerox is the best known of the roughly two dozen companies offering plain-paper copiers, and demand for paper for this type of machine is likely to grow dramatically in future years as a result of color copying capabilities, high-speed copiers, intelligent copiers, and other developments. Most copiers use cut-size, 8 x 11- or 8 x 14-in. paper, but a few, such as the IBM Copier II and the Xerox 1860, are roll-fed. High-speed copiers can achieve rates of 120 pages per minute or more, while inexpensive copiers may produce as few as six pages per minute. Both liquid or dry toners are used.

The same paper machines that make offset and bond papers are used to produce plain-paper copy papers, which have similar characteristics and are produced from chemical pulps.

A number of paper qualities create challenges to be met

COVER AND TEXT PAPERS: TYPICAL GRADE STRUCTURE

Text		Cover	
Basis weight (25 x 38, 500)	Grammage (g/m²)	Basis weight (20 x 26, 500)	Grammage (g/m²)
60	53	50	135
65	96	60	162
70*	103	65*	176
75	111	80*	216
80*	118	90	243
100	140	100	270

* Major weights.

by copy paper mills, according to George Treier, principal engineer at Xerox's Paper Technology Center. These include:

- Surface strength, internal bonding, and reduction or elimination of sheet contamination. The focus will be on image retention, adequate levels of surface sizing, and use of fillers at levels below "dusting" thresholds so components will not be contaminated. Edge cleanliness and cut quality will also have to be optimized in the finishing operation in order to result in a noncontaminating product.
- Dimensional stability and sheet flatness. These characteristics are important both for general reliability and to facilitate complete image transfer in many of the newer transfer systems. This means papermakers will have to pay attention to moisture uniformity, proper moisture content, drying conditions, and reduction of any cockling or puckering tendencies from other areas of the process.
- Sheet cleanliness through an absence of dirt speck, shives, or inclusions from any source within the total area of the sheet.
- Reduced sheet abrasiveness, because high throughput rates tend to increase component wear and the relatively fragile organic photoreceptors can be damaged by mechanical abrasion. A current major problem is deposition of abrasive paper fillers within the machine.

Paper used for nonimpact printers and facsimile machines—dielectric paper for nonimpact printers and facsimile transmission—also probably will experience strong increases in demand, but other coated copy paper demand will remain weak.

As supported by the Dataquest evidence, copy papers are likely to benefit from continued development of the electronic office, which includes not just video display terminals and electronic data transmission services but also the intelligent copiers mentioned previously. These machines can create forms, print on both sides of the paper

PAPER SHIPMENTS TO U.S. BOOK PUBLISHERS, 1980-87

(000 short tons)

Year	Coated two-sides	C2S Nos. 1-4	C2S No. 5	Uncoated free-sheet	Uncoated groundwood	Total
1987	300	245	53	560	70	930
1986	298	238	60	524	68	890
1985	280	223	57	454	53	787
1984	289	219	70	482	70	841
1983	250	190	60	435	75	760
1981	250	165	85	460	105	815
1980	240	150	90	475	115	830

Source: *Pulp & Paper* estimates.

TYPICAL BULKS FOR BOOK PAPERS AT DIFFERENT BASIS WEIGHTS AND SHEET FINISHES

	Standard bulks			
Basis weight (25 x 38, 500)	Antique (ppi)*	Eggshell (ppi)	Standard (ppi)	Eng. finish (ppi)
45	—	492	540	600
50	410	440	488	540
55	360	386	444	500
60	330	364	408	440
70	288	316	350	390

* ppi = Pages (sheets) per inch.

Source: International Paper Co.

in a single operation, sort, collate, and staple, virtually replacing inplant printing operations. Papermakers will see increased demand for these papers because the machines allow for increases in the number of reports, brochures, and other documents that can be cheaply and quickly printed by many offices.

FORMS BOND

Forms bond papers are manufactured to be printed on high-speed, continuous data-processing equipment that employs direct-impact printing methods. Forms paper qualities are similar to those of offset printing papers, and paper mills with the capability to make both grades sometimes switch back and forth, depending upon market conditions.

Forms bond requires characteristics such as good stiffness and strength for fast feeding and printing and for refolding without distortion, a good printing surface that is free of lint, good dimensional stability for perfect register, and a high degree of paper cleanliness.

This paper segment, unlike other uncoated free-sheet grades, competes directly with uncoated groundwood grades that are substantially less expensive. A top-quality forms bond is made of 100% chemical pulp fiber, often made by blending softwood and hardwood kraft pulps. Forms paper also may have some secondary (recycled) fibers or groundwood pulp as a cost- and price-cutting measure. The price for blended (free-sheet/groundwood) forms sheets can be as much as 25% below free-sheet bond in a normal market, while the primarily groundwood forms papers are priced at around 50% below free-sheet prices.

The industry's leading producers of free-sheet forms bond include Boise Cascade Corp., International Paper Co. (primarily through its Hammermill unit), Mead Corp., Union Camp Corp., and Georgia-Pacific Corp., while G-P also makes blended bonds and Abitibi-Price Inc. and Great Northern Nekoosa Corp. are strongest in groundwood forms paper. Groundwood forms paper often is not surface-sized, thus reducing printing press runability and printability. Groundwood paper also has lower brightness and opacity than the free-sheet product, but, as stated, it is substantially cheaper.

The less expensive groundwood forms mostly are for internal record-keeping, where appearance is not important. Not so with blended bonds, which often are surface-sized and may have a good appearance as well, thus offering an attractive middle road between the two extremes. In times of free-sheet discounting, however, the blended product seems to get squeezed out.

Groundwood forms producers have worked steadily to improve the quality of the sheet in order for it to run successfully through high-speed printers. A marketing executive with a company making blended bonds said he considers such a groundwood product to be among his biggest single competitive worries since it would remove an important advantage of blended bonds.

Of all paper shipments in 1987 to U.S. business forms converters, uncoated free-sheet bond represented 92%, reaching almost 2.8 million tons. Uncoated groundwood, at 228,000 tons, made up the balance, except for the minute (0.2%) coated bond. The groundwood segment began to decline at the beginning of the 1980s, falling about 4.5% between 1982 and 1986 and dropping another 6% in 1987. At the same time, uncoated free-sheet for forms rose almost 44%, gaining an additional 3% in 1987.

Forms industry sales are expected to grow about 23% between 1985 and 1990, with strongest growth in stock continuous forms (31.7%). Sales of custom continuous forms also will grow about 23.6%, according to a projection from International Business Forms Industries Inc. (IBFI), an industry association.

Also used in multi-part continuous forms is carbonless paper. Basestock for carbonless coating represents a market of almost 600,000 tpy; it grew almost 45.4% from 1982 through 1986 and over 10% from 1986 to 1987. This paper is discussed in depth later.

Aside from competition from groundwood forms paper, uncoated free-sheet papers have experienced another trend—a slow but steady rise in basis weights, due in part to the

COMMON BASIS WEIGHTS FOR BMDX GRADES

Basis weight (17 x 22, 500)	Grammage (g/m^2)	Bond	Mimeograph	Duplicating	Copy
13	49	X			
16	60	X	X	X	
18	68	X	X	X	
20	75	X	X	X	X
24	90	X*	X		X
28	105	X*			
32	120	X*			
36	135	X*			

* Ledger grades.

increased preference for heavyweight single-part forms as opposed to lightweight multi-part forms. A study conducted earlier in the 1980s indicated that the average basis weight of U.S. forms bond production rose from 15.1-lb in 1972 to 16.1-lb in 1980, with the 10- to 14-lb range falling from 34.3% of all forms bond in 1972 to 21.1% in 1980. In that time, 16- to 25-lb paper rose from 21.9% of the market to a 39.7% share. The 18- to 20-lb range is the most substantial for one-part forms.

Also affecting forms bond has been the jump in the number of small personal and business computers installed in recent years, as indicated in the Dataquest study. These computers, along with word processors, use both stock continuous forms and cut-size paper, and their projected popularity will guarantee a healthy growth rate for forms bond in coming years. Most observers expect an overall forms bond growth rate in coming years of about 6% annually. Forms bond capacity has risen in recent years. A new machine came online in the early 1980s at Willamette Industries Inc.'s 100,000-tpy Hawesville, Ky., mill. The company will add another 200,000-tpy greenfield paper mill in South Carolina. This mill, scheduled to be online in 1990, will produce mostly forms bond and copy papers. There were also incremental increases at Mead's Chillicothe, Ohio, mill (35,000 tpy) and Boise Cascade's Vancouver, Wash., mill (12,000 tpy), among others. Production on Boise's new 300,000-tpy machine in Minnesota also includes forms, reprographic, and other free-sheet papers.

U.S. PRICES FOR UNCOATED WHITE PAPER

($ per short ton)

	Bookpaper No. 3 offset +45-lb sheets	Bond, No. 4 unwatermarked 20 to 24-lb sheets	No. 1 watermarked +20-lb sheets	Forms bond 15-lb rolls	Bond 25% cotton sheets
1987					
4Q	$850	$820	$980	$760	$1,990/2,060
3Q	820	727-747	(920)/985	760	1,900
2Q	820	760	(930)/985	720*	1,810
1Q	820	(720)/820	(930)/935	720*	1,810
1986					
4Q	850	820*	985*	720	1,810
3Q	850	807	985	687	1,810
2Q	(840)	(760)	985	(660)	1,810
1Q	(800)	(760)	985	(620)	1,810
1985					
4Q	(800)	(760)	985	(600)	1,810
3Q	(817)	(773)	985	(640)	1,810
2Q	(830)	(760)	985	(660)	1,810
1Q	(790)	(733)	985	(660)	1,810
Year-end					
1984	(880)	(773)	985	(693)	1,810
1983	840	810	960	745	1,650/1,730
1982	680	640	916	640	1,650
1981	878	867	916	753	1,650
1980	813	803	848	697	1,490
1979	711/717	720	778	620	1,309/1,343
1978	645	640/644	695	538/550	1,190/1,230
1977	548/555	548/590	645/650	450/500	1,143
1976	506	561	628	519/520	1,083
1975	484	550	605	495/504	1,012
1974	535	559	637	470	984
1973	457	495	n.a.	n.a.	734
1972	460	470	n.a.	n.a.	728
1971	455	460	n.a.	n.a.	719
1970	442	445	n.a.	n.a.	n.a.

( ) indicates estimated transaction prices where most volume is moving significantly below list.
* Discounting from list prices reported.
n.a. = Not available.

Source: *Pulp & Paper Pricebook, Pulp & Paper Week.*

CARBONLESS PAPER

The familiar and messy blue or black carbon paper is being replaced by carbonless paper. The most common end uses are business forms, order books, and charge card receipts. With carbonless paper, the image is transferred from the top or "donor" sheet to succeeding sheets with the aid of an encapsulated dye coated onto the back side of the paper. When the top surface is imprinted, the pressure breaks the dye on the back and the image is transferred to the top of the next sheet. The receiving side is coated with kaolin clay in order to enhance the sharpness of the received image. This system can make up to five replicas.

In making a carbonless forms unit, the basestock (cb) for a carbonless form is produced from high-quality chemical pulps on a standard fourdrinier paper machine, with the receiving sheet being coated on the paper machine and the stock then going to an off-machine coater for the encapsulated dye. When more than two sheets are desired for a set of forms, the intermediate sheets (cfb) are coated on the front with kaolin and on the back with dye. The last sheet (cf) is coated on the front but not on the back, with a top coating to receive the image.

Industry observers said U.S. carbonless production reached almost 600,000 tons in 1987, up more than 10% from 1986. In contrast, one-time carbonizing production was just under 110,000 tons in 1987, down more than 7% from 1986. Worldwide, carbonless production is expected to rise into the next decade, hitting 2.2 million tons by 1990. A major converter expects carbonless papers to move from about 45% of the multi-part forms market to at least 60% in several years. The leader in production of carbonless basestock is Appleton Papers Inc., although Mead also is a force in the market. Appleton also is a major converter and, as such, converts the basestock into forms by applying the dye on off-machine coaters and then rolling the paper into

CARBONIZING BASESTOCK AND CARBONIZING TISSUE PRODUCTION

(000 short tons)

Year	Carbonizing	Carbonless
1987	109	600
1986	117	539
1985	125	498
1984	141	443
1983	150	390
1982	180	370
1981	180	320
1980	181	295

Source: *Pulp & Paper* estimates.

FORMS BOND: TYPICAL GRADE STRUCTURE

Basis weight (17 x 22, 500)	Grammage (g/m²)
9	34
10	38
12	45
15	53
16	56
18	68
20	75
24*	90
28*	105
32*	120

* Ledger/tag weights.

CARBONIZING TISSUE PRODUCERS

	Company/Mill	1987e production (short tons)
1.	Burrows Paper Corp. Little Falls, N.Y.	n.a.
2.	Consolidated-Bathurst Inc. Trois Rivières, Que.	12,676
3.	Dunn Paper Co.[1] Port Huron, Mich. Wiggins, Miss.	30,000
4.	Fletcher Paper Co.[2] Alpena, Mich.	n.a.
5.	Fraser Paper Ltd. Madawaska, Maine	n.a.
6.	International Paper Co. Jay, Maine	n.a.
7.	James River-Otis Inc.[3] Jay, Maine	2,000
8.	Port Huron Paper Co. Port Huron, Mich.	n.a.
9.	Seaman Paper Co. Otter River, Mass.	n.a.
10.	Thilmany Pulp & Paper Co. (Div. of Hammermill) Kaukauna, Wis.	31,679

e = Estimate.
n.a. = Not available.
1. Bought by James River Corp., 1987.
2. Hot spot carbonizing.
3. Carbonizing bond.

Source: Company data.

sets. Other major converters include 3M Co., Moore Business Forms (based in Canada), Standard Register Co., and Nashua Corp. Mead developed a process called "opas" that allows production of carbonless forms at printing plants by modifying existing offset presses, thus allowing printers to expand their use of carbonless paper.

Moore is moving strongly away from blue-image and into black-image carbonless. Other large producers and converters, such as Standard Register, also are changing some of their production away from blue-image paper.

THIN PAPERS

Thin papers are much like tissue paper and can be used to produce a variety of products, including one-time carbonizing tissue, cigarette and condenser papers, bible paper, and other papers for specialized uses. (Lens cleaning and stencils are two such minor uses.)

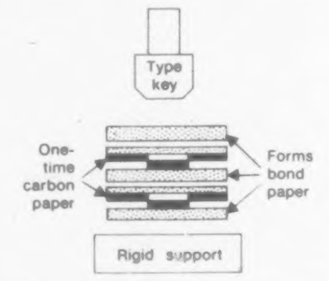
One-time carbonizing paper is the major product, accounting for about 99% of thin paper produced in 1987. To produce this paper, carbon black or pigments are coated onto a bleached or unbleached basesheet by a converter and then combined with a bond sheet to form one-time carbon paper. One-time carbon forms are losing market share in multi-part forms at about the same rate as carbonless is gaining. A study by IBFI reported that in 1985 carbonless represented about 29% of the stock continuous market, with 71% going for carbon-interleaved. The market shift toward continuous forms—especially those produced on office computers and intelligent copiers capable of generating a form and filling it in, using a blank roll of forms paper—has eroded the share of the forms market represented by multi-part forms. IBFI said one-part forms were about 67% of stock continuous shipments in 1985 and rose to 72% in the U.S. in 1987.

Basis weights of thin papers range widely, but a typical weight (20 x 30-in., 500 sheets) would be 8.65 lb. The sheet is made on a yankee fourdrinier paper machine at medium speeds of 2,000 fpm, with chemical furnish used, and it is refined to form a tight sheet devoid of pinholes.

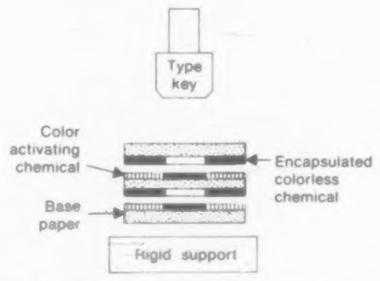
Another important part of the grade is cigarette paper, which is a strong, highly filled lightweight product made largely from flax straw. The controlled burning rate is accomplished by heavily filling the paper with precipitated calcium carbonate. Principal producers in the U.S. are P.H. Glatfelter Co.'s Ecusta Paper Div. and Kimberly-Clark Corp.'s Schweitzer Div.

The other primary thin paper product is electrical paper, which includes a number of grades such as insulating, condenser, capacitor, and dielectric, although the condenser and capacitor papers fall under the thin paper classification. Production of these papers probably is less than 20,000 tpy combined. However, some electrical papers, such as insulating paper, are listed under "special industrial papers," and their tonnages are not included in estimates here. They are discussed elsewhere in this book.

ONE-TIME CARBON AND FORMS BOND PAPER



CARBONLESS PAPER FORM



COTTON-FIBER PAPER

Containing between 25% and 100% cotton fiber, cotton-fiber papers are used as premium-quality bond papers, technical papers, and for other special uses which require permanence and durability—such as paper currency, financial certificates, and postage stamps.

The "rag content" in the pulp used in making these papers generally comes from (1) new cotton cuttings from the textile and garment industry (and formerly old rags), and (2) from linters.

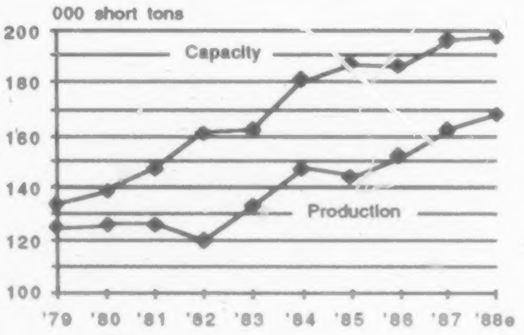
Cotton linters are the short fibers adhering to cotton seed after the ginning operation and consist of the stumps or bases of the longer staple textile fibers and short fuzz fibers. The cotton cuttings from new cotton fabrics are generally classified according to textile source—unbleached muslin, white shirt cuttings, light prints, blue denims, etc.

Cotton, in the form of either the staple fiber used in the textile industry or of cotton linters, is the purest natural form of cellulose (98% to 99% alpha content) and this gives cotton-content paper its durability.

The cotton fibers used in cotton-content papers are usually blended with sulfate or sulfite woodpulps. The blended pulp is highly refined or beaten to develop a sheet with crackle and good strength. It is sized internally (beater sizing) to produce a proper level of holdout to inks. When a cockle finish is desired, the sheet is air-dried.

Competition for cotton fibers from clothing and other industries has reduced availability of 100% cotton scraps, and made 100%-cotton bond scarce and expensive. Sulfite bond has been used as a substitute because of its purity and permanence compared with sulfate papers.

CAPACITY AND PRODUCTION, 1979-88



e = Estimate

Source: American Paper Institute.

COTTON-CONTENT PAPERS: GRADE DISTRIBUTION

(short tons)

Year	Total writing, cotton-fiber	Bond and writing
1987e	161,400	133,000
1986	161,063	124,688
1985	144,860	126,006
1984	143,876	124,770
1983	160,172	131,430
1982	133,531	116,355
1981	112,987	89,856
1980	130,823	92,876
1979	130,286	91,389
1978	119,204	85,547

e = *Pulp & Paper* estimate.

Source: Bureau of the Census.

Cotton-content papers are generally sold in a range of basis weights: 9, 13, 16, 20 and 24 lb (17 x 22-in., 500 sheets). They are also labeled according to sheet finishes such as light cockle, cockle, smooth, vellum, and linen. In addition, they are categorized according to their colors and sheet properties (which include whiteness, opaqueness, onionskin).

Production of cotton-content papers has been relatively static in recent years. U.S. production in 1978 was 119,000 tons. It rose to 130,000 tons in 1979 and 131,000 tons in 1980, but then fell to 113,000 tons in 1981, rising again to 134,000 tons in 1982, 160,000 in 1983, 144,000 in 1984, and 145,000 in 1985, according to the Dept. of Commerce.

American Paper Institute statistics are somewhat higher, though. According to API, shipments of cotton-fiber papers reached 147,000 tons in 1984, dropped to 144,000 in 1985, and then rose to 152,000 in 1986 and 161,000 in 1987. The 5.7% increase in 1987 from 1986 equals the increase for the whole printing and writing sector.

NORTH AMERICAN PRODUCERS OF COTTON-CONTENT PAPERS

Company/mill	Capacity[1] (tons/day)
1. Sorg Paper Co., Middletown, Ohio[2]	320
2. Eastern Fine Paper, Brewer, Maine[3]	180
3. Kimberly-Clark Corp., Neenah, Wis.[4]	175e
4. Crane & Co. Inc., Dalton, Mass.	140
5. Howard Paper Mills Inc., Dayton, Ohio	125
6. Beckett Paper Co., Hamilton, Ohio[5]	119
7. Strathmore Paper Co., Turners Falls, Millers Falls, Westfield, and Woronoco, Mass., mills (5)	109
8. Gilbert Paper Co., Menasha, Wis.[6]	95
9. Fletcher Paper Co., Alpena, Mich.	85
10. Domtar Inc., Fine Paper Div., Beauharnois, Que.	80
11. Monadnock Paper Mills, Bennington, N.H.	75
12. Byron Weston Co., Dalton, Mass.[7]	60
13. James River-Fitchburg Inc., Fitchburg, Mass.	60
14. Rising Paper Co., Housatonic, Mass.	52
15. Parsons Paper Co., Holyoke, Mass.[8]	25
16. Curtis Paper Co., Newark, Del.[9]	24
17. Simpson Paper Co., Harding-Jones mill, Middletown, Ohio	22
18. Southworth Co., W. Springfield, Mass.	20
19. Esleeck Mfg. Co., Turners Falls, Mass.	18

e = Estimate.
1. Total mill capacity including fine papers.
2. Division of Mosinee Paper Corp.
3. Affiliate of Eddy Paper Co. Ltd.
4. Includes Whiting mill in Stevens Point, Wis.
5. Division of Hammermill Paper Co.
6. Division of Mead Corp.
7. Subsidiary of Crane & Co. Inc.
8. Division of NVF Co.
9. Division of James River Paper Co.

Demand is likely to grow just over 6% between 1986 and 1995.

Pricing for cotton-fiber papers was aggressive until 1983, partly to offset rapidly rising costs for cotton cuttings and linters; increases have been smaller since 1983. The price of 25%-cotton-content bond paper rose about 84% between 1974 and 1985, although a minimal gain was recorded in 1983 from 1982.

Cotton bond pricing saw its strongest leap in 1980, with an increase on 25% cotton bond in sheets moving to a yearly average of $1,442/short ton from $1,274 in 1979. Subsequent years saw increases varying from 7.4% to a mere 0.6% in 1983 over 1982, and no effective increase in 1986 from 1985. Indeed, by year-end 1984 the price for 25% cotton in sheets had risen to an average of $1,810/short ton and hit $2,125 by second-quarter 1988.

Only about 20 companies, with small mills mainly in the Northeast and upper Midwest, produce any significant tonnage of cotton-fiber papers. Because most of these mills can also produce bond-type grades from 100%-chemical-pulp furnish, production is controlled mainly by demand rather than capacity.

Capacity for these grades has remained relatively flat for the past 15 years, according to API figures. Since 1969, when it reached 159,000 tons, capacity has risen and fallen slightly, reaching just 186,000 tons in 1986. By 1990, API forecasts, capacity will rise to 199,000 tons.

PRICING TRENDS FOR BOND PAPERS

($/short ton)

Year-end	Forms bond[2]	25% cotton[3]
1988[1]	$850/870	$2,125
1987	760	1,990-2,060
1986	(672)	1,810*
1985	(640)	1,810
1984	762	1,750
1983	745	1,650/1,730
1982	(640)	1,650
1981	753*	1,549
1980	697	1,490
1979	620	1,343
1978	544	1,210
1977	475	1,143
1976	520	1,083
1975	500	1,012
1974	470	984
1973	—	728
1972	—	719

( ) Indicates estimated transaction prices where volume is moving significantly below lists.
* Discounting from list prices reported.
1. Second quarter.
2. Average price for rolls.
3. Average price for sheets.

Sources: *Pulp & Paper Week*, *Pulp & Paper Pricebook*.

BRISTOLS

GRADE STRUCTURE

Bristol papers are bleached or semibleached kraft stock, slightly lighter in weight than bleached boards but heavier than true printing and writing grades, usually with a thickness or caliper of 0.006 in. or more.

Essentially, bristol grades are broken down into seven segments: tabulating index, tag and file folder, index bristols, printing bristols, postcard, and coated bristols, as well as mill or bogus bristols, which are bristol-type recycled paperboards made on cylinder paper machines.

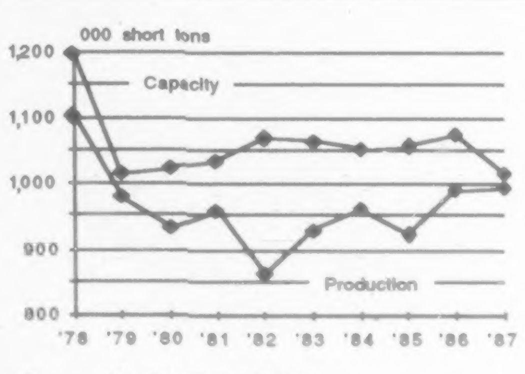
Tabulating stock is used primarily for computer tab cards and must have superior dimensional stability and electrical characteristics. It is produced on fourdrinier paper machines from semibleached kraft pulps.

Printing bristols are used in a variety of ways, and they can be either coated on one side or uncoated. Many have characteristics similar to other cover grades. Lower-caliper (below 0.015 in.) coated bristols are produced on fourdrinier paper machines from a blend of bleached hardwood and softwood kraft pulps. Hardwood improves the printing surface and adds bulk.

Mill or bogus bristols extend the availability of printing bristols to calipers of 15 points and higher. They are produced by a number of companies making specialty paperboard.

Index bristols have a fairly good printing surface that is extremely erasable. Both tag and index bristols are normally produced on fourdrinier paper machines. Although both grades are similar, tag bristol is stronger and more durable.

CAPACITY AND PRODUCTION, 1978-87



Source: American Paper Institute.

U.S. STATISTICS FOR BRISTOLS*

	1987e	1986	1985	1984
Production,[1] 000 tons	995	990	930	959
Capacity, 000 tons	1,018	1,025	1,059	1,031
Utilization rate,%	97.7	96.6	87.8	91.2
Imports, tons	965	700	1,024	667
Exports, 000 tons	1.9	2.4	1.4	3.0
Apparent U.S. consumption				
000 tons	1,958	1,688	1,947	1,623
lb/capita	16.1	14.0	16.3	6.9
000 tons/$ billion real GNP (1972)	0.50	0.53	0.54	1.00

* All tons are short tons.
e = Estimate.
1. Bleached bristols.

Sources: American Paper Institute, *Pulp & Paper* estimates.

Coated bristols have end uses such as calendars, greeting cards, and directory covers.

The major producers of bristol grades include International Paper Co., Federal Paper Board Co. Inc., Temple-Inland Inc., Union Camp Corp., James River Corp., Champion International Corp., and a number of smaller mills.

OUTLOOK

Overall demand for bristols has shown slow growth in recent years, rising at about a 1%/year rate over the past decade. The main reason for this sluggish growth, however, has been the sharp drop in the market for tab card stock, which fell from about 500,000 tons in 1970 (almost half of total tonnage) to only about 116,000 tons in 1987. Excluding tab card, demand for bristols has been more respectable—at about a 5%/year rate over the last decade.

About 895,000 tons of bristols (excluding tab index) were shipped by U.S. mills in 1987, according to the American Paper Institute. That translated into an operating rate well below 90%, down from about 91% in 1986 and 92% in 1985. Demand for bristols has shown big swings in recent years, including an upsurge in 1984 caused by the popularity of a board game called Trivial Pursuit, which used quite a few tons of coated bristols, according to one producer.

Government statistics place U.S. bristol production in 1986 at 990,000 tons, up from 930,000 tons in 1985 and the highest level since 1979. These figures may not be totally accurate, however, because a number of bleached board producers have been selling their products in bristol markets. New machine technology has allowed the mills to reduce board thickness from the standard 15-pt board to 10-pt. This has caused a controversy about the way the industry tallies bristol production because bristol producers feel that the bleached board sold in bristol markets should be counted as bristols. This would increase production estimates by 10% to 15%.

As previously noted, the segment of the bristol market that has suffered the biggest decline is tabulating card stock,

U.S. CAPACITY TRENDS FOR BLEACHED BRISTOLS

Year	Annual capacity (000 short tons)	% change
1990e	1,036	–0.1%
1989e	1,037	–0.1
1988e	1,038	2.0
1987e	1,018	–0.7
1986	1,025	–3.8
1985	1,059	0.1
1984	1,058	1.0
1983	1,049	–1.8
1982	1,062	0.2
1981	1,060	3.5
1980	1,024	0.4
1979	1,020	–14.6
1978	1,194	2.5
1976	1,165	–5.7
1974	1,235	6.9
1972	1,155	3.9
1970	1,112	6.2
1969	1,047	—

e = Estimate.

Source: American Paper Institute.

BLEACHED BRISTOL PRODUCTION BY GRADES

(000 short tons)

Year	Total	Tabulating	Tag	Folder	Index, printing, postcard[1]	Coated
1987	995	—	181	188	276	350
1986	990	—	182	178	270	360
1985	894	70	200	164	194	266
1984	940	68	214	141	215	302
1983	928	107	215	149	240	217
1982	834	123	181	117	200	213
1981	1,083	142	194	127	330	290
1970	1,155	500	186	72	218	179
% change 1970-87	–13.9%	—	–2.7%	161.1%	26.6%	95.5%

1. After 1985 includes tabulating cardstock.

Source: *Pulp & Paper* estimates.

reflecting displacement by other types of computer storage media, such as tape and disks.

Production of bristol grades used in offices, such as file folders and index stock, has grown markedly, despite dire warnings that computerized file systems would replace traditional record-keeping methods. Some analysts think this may still happen, but statistics indicate that, for now, offices still cling to paper files, at least as backup for computer files and for information not worth spending the time to input on computers. Production of bristols for file folders increased from only 70,000 tons in 1970 to 190,000 tons in 1987. Index bristols, however, have shown a relatively flat growth trend, and in 1987 shipments totaled 116,000 tons, down about 4% from 1986. Coated bristols

PRODUCERS OF BRISTOL GRADES

Mill bristol*

Beveridge Paper Co.
Indianapolis, Ind.

Boise Cascade Corp.
Sheldon Springs, Vt.
Beaver Falls, N.Y.

Byron Weston Co.[1]
Dalton, Mass.

Lowe Paper Co.
Ridgefield, N.J.

Sonoco Products Co.
Holyoke, Mass.

Index/printing

Boise Cascade Corp.
Brownville, N.Y.
Beaver Falls, N.Y.

Champion International
Hamilton Ohio

Domtar Inc.
St. Catharines, Ont.
Toronto, Ont.
Beauharnois, Que.

E.B. Eddy Forest
Products Ltd.
Brewer, Maine
Hull, Que.

Federal Paper Board Co. Inc.
Augusta, Ga.
Riegelwood, N.C.

Fox River Paper Co.
Appleton, Wis.

Mead Corp.
Gilbert Paper Co.
Menasha, Wis.

International Paper Co.
Bastrop, La.
Moss Point, Miss.

James River-Fitchburg
Fitchburg, Mass.
Milford, N.J.

Kimberly-Clark Corp.
Neenah, Wis.

Mohawk Paper Mills Inc.
Cohoes, N.Y.
Waterford, N.Y.

Plainwell Paper Co.
Plainwell, Mich.

Rising Paper Co.
Housatonic, Mass.

Rolland Inc.
St. Jerome, Que.

Scott Paper Co.
Mobile, Ala.

Simpson Paper Co.
Vicksburg, Mich
Miquon, Pa.

Sorg Paper Co.
Middletown, Ohio

Strathmore Paper Co.[2]
Westfield, Mass.

Temple-Eastex Inc.
Evadale, Texas

Union Camp Corp.
Franklin, Va.

Wausau Paper Mills Co.
Brokaw, Wis.

Whiting Paper Co.
Menasha, Wis.

Tag

Boise Cascade Corp.
Brownville, N.Y.
Beaver Falls, N.Y.

Domtar Inc.
St. Catharines, Ont.
Toronto, Ont.

International Paper
Bastrop, La.
Georgetown, S.C.

Island Paper Mills Inc.[3]
New Westminster, B.C.

James River-Fitchburg Inc.
Fitchburg, Mass.

James River Corp.
Warren Glen, N.J.
Milford, N.J

Merrimac Paper Co.
Lawrence, Mass.

Potlatch Corp.
Lewiston, Idaho

Rolland Inc.
Mont Rolland, Que.

Simpson Paper Co.
Miquon, Pa.

Sorg Paper Co.
Middletown, Ohio

Temple-Eastex Inc.
Evadale, Texas

Union Camp Corp.
Franklin, Va.

Postcard

Domtar Inc.
Cornwall, Ont.

Eastern Fine Paper Inc.[4]
Brewer, Maine

Hennepin Paper Co.[5]
Little Falls, Minn.

International Paper Co.
Mobile, Ala.
Ticonderoga, N.Y.

James River Corp.
Hyde Park, Mass.
Hughesville, N.J.

Lowe Paper Co.
Ridgefield, N.J.

Pejepscot Paper
Brunswick, Maine

Sorg Paper Co.
Middletown, Ohio

Wausau Paper Mills Co.
Brokaw, Wis.

* Includes bogus bristols and heavyweight bristols from bleached kraft used for posters, etc.
[1] Division of Crane & Co. Inc.
[2] Division of Hammermill Paper Co.
[3] 50% owned by MacMillan Bloedel Ltd., 50% owned by Fraser Inc.
[4] Division of Eddy Paper Co. Ltd.
[5] Subsidiary of Carlyle Investment Corp.

for printing have shown the strongest growth, rising from 174,000 tons in 1970 to 355,000 tons by 1987.

There are some expanding markets for bristol grades. Automated airline ticketing and boarding pass machines got a big boost in 1986 when United Airlines announced it would phase in card-type tickets. These ticket cards have magnetic stripes on the back with encoded flight information. These tickets are supposed to eventually replace the more familiar multi-part carbon paper variety, which is made of groundwood stock.

According to Communication Information Services Inc., a Pleasant Hill, Calif.-based market research firm, overall demand for bristols should rise at a 2.3% annual rate over the 1986-95 period, compared with a 1% rate during 1976-85. Demand for bristols excluding tab card stock is expected to grow at 3% annually over the decade. Coated bristols may grow at a somewhat higher 4.4% annual rate in ten years.

Capacity increases have been gradual in recent years, following declines in the 1970s that kept the market tight. In 1979, when capacity fell to a low of just over a million tons, the operating rate reached a high of 104.6%. In 1987, capacity was expected to reach 1.018 million tons. The American Paper Institute estimates capacity will rise to 1.036 million tons by 1990. Bristol capacity is somewhat hard to pinpoint, however, because of the confusing delineation between bristols and other grades, including uncoated free-sheet, bleached board, cover/text, and boxboard. Most industry executives suspect that bristol capacity is somewhat higher than is officially reported.

Bristol prices have held up better than prices for some other related grades of paper and paperboard, which are more vulnerable in economic slowdowns. During the 1981-82 recession, pricing for bristol grades was substantially stronger than for other sectors that suffered from heavy discounting. In fact, some bristol price increases were effected in early 1982 at a time when almost no other printing/writing grades were going up in price. Bureau of Labor Statistics figures indicate that file folder stock prices

BRISTOLS: TYPICAL GRADE STRUCTURE

Grade	Uses, basis-weight ranges	
INDEX: (uncoated)	Sales lists, manuals, record folders, file cards.	
	Basis:	25½ x 30½ in., 500
	Weights:	80 lb (145 g/m^2)
		90 lb (163 g/m^2)
		110 lb (199 g/m^2)
		140 lb (253 g/m^2)
		170 lb (307 g/m^2)
		220 lb (398 g/m^2)
TAG: (uncoated)	Tags, ruled forms, timecards, menus, folders, catalog inserts, display cards.	
	Basis:	24 x 36 in., 500
	Weights:	90 lb (146 g/m^2)
		100 lb (163 g/m^2)
		125 lb (203 g/m^2)
		150 lb (244 g/m^2)
		175 lb (285 g/m^2)
		200 lb (325 g/m^2)
POSTCARD[1]: (uncoated)	Return mailers, bills/ statements.	
	Basis:	22½ x 28½ in., 500
	Weights:	57 lb (125 g/m^2)
		67 lb (147 g/m^2)
		80 lb (176 g/m^2)
MILL BRISTOLS[2]: (uncoated or coated 1-S)	Promotional folders, posters, point-of-purchase displays, tent cards, covers, etc.	
	Caliper:	0.080 in.
		0.010 in.
		0.012 in.
		0.015 in.
		0.018 in.
		0.020 in.
		0.024 in.

1. Approximate calipers: 0.009 in. for 67 lb, 0.0075 in. for 57 lb.
2. A wide range of grades, including bogus bristols. The higher-caliper grades, above 15 pt, could be produced on cylinder machines. Also available in higher calipers.

PRODUCTION TRENDS FOR BLEACHED BRISTOL

(000 short tons)

		Grades		
	Total	Tabulating index	Other uncoated	Coated
1987	995[1]	181[2]	464[2]	350[2]
1986	990[1]	182[2]	448[2]	360[2]
1985	894	70	558	266
1984	940	68	570	302
1983	928	107	604	217
1982	834	421	200	213
1981	904	462	209	231
1980	960	476	250	234
1978	1,094	593	229	272
1977	1,034	572	209	252
1976	1,012	599	203	209
1975	936	594	169	173
1974	1,185	712	254	218
1973	1,209	796	190	223
1972	1,062	768	156	138
1971	976	735	135	106
1970	997	771	137	88

1. American Paper Institute data.
2. *Pulp & Paper* estimates.

Source: Bureau of the Census.

have not slipped in recent years and have posted annual gains since the early 1970s of as much as 23.2%, although more modest increases have been registered recently. The price gain in 1984 was 4.3%, and in 1985 prices rose by 4.6%. But they rose only 0.3% in 1986 and 1.8% in 1987.

When the economy began to recover late in 1983, uncoated bristols rebounded sharply, posting a $50/ton price hike effective Jan. 1, 1984. Weakening in the overall printing and writing papers market later in the year, however, caused some price weakness. Demand picked up in 1985, and a $20/ton price increase went into effect in September and again in October 1986. Additional increases of $25 to $50/ton were implemented in 1987 as was a $50/ton increase on coated bristols in April 1988. File folder stock prices improved to around $585/ton in 1987, and coated bristols moved to the $800/ton level.

BLEACHED BRISTOLS: U.S. PRICE HISTORY*

	Manila tag[1]	Manila file folder	C1S[2]
1988	$755	$620	$820
1987	715	585	800
1986	715	585	800
1985	675	640	760
1984	675	640	760
1983	675	576	720
1982	581	576	670
1981	581	576	640-670
1980	521-546	521-541	565-585-605
1979	481	481	520

* Published list prices; years with multiple prices include more than one price increase that year.

1. Rolls, greater than or equal to 125-lb basis weight (24 x 36, 500 sheets).

2. Coated one-side, 14-pt. caliper.

PACKAGING AND INDUSTRIAL CONVERTING

GRADE STRUCTURE

Packaging and industrial papers include a wide range of unbleached and bleached papers, divided into three general categories: (1) unbleached packaging and industrial converting grades used for grocery bag and sack, shipping sack, wrapping, and other converting papers 18-lbs and over; (2) bleached packaging and industrial converting grades used for similar end uses; and (3) special industrial papers used in the manufacture of abrasives, electrical insulators, gaskets, filters and other products. The bleached grades also include glassine, greaseproof, and vegetable parchment papers used for specialty packaging.

Unbleached grades account for close to 60% of total production, with bleached and specialty packaging grades accounting for nearly 20%, and special industrial about 20%. The most familiar products made from kraft paper are grocery sacks, shipping sacks, and retail merchandise bags. The four major end uses for unbleached and bleached kraft packaging and industrial converting papers are (1) bag and sack, accounting for about 57% of shipments; (2) shipping sack, about 25%; (3) wrapping, 3%; and (4) other converting, 15%.

Kraft papers for bag and sack are made in a range of basis weights. Small bags designed to hold from 1/4 lb to 25 lbs of product are made from kraft papers with basis weights of 30, 35 or 40 lb/3,000 ft^2, which is equivalent to 49 to 65 g/m^2. In contrast, sacks are designed to hold more product and are made from paper with basis weights of 40 to 80 lb/3,000 ft^2, or 65 to 130g/m^2. Typical sack weights are 40, 52, 57, 65, 70, 75 and 80 lb. Standard grocery sacks use 70-lb kraft paper, while 50-lb paper is used in shipping sacks.

Since bags and sacks are made for many types of uses, their weight, style and construction are tailored to each end use. Bags and sacks are standardized in four sizes (1/8, 1/6, 1/5, and 1/4 of a bushel) and are primarily produced in one of four styles: (1) flat, (2) gusset, (3) satchel-bottom, and (4) self-opening. Sack construction may also be single-wall, heavy single-wall, duplex, or multiwall. If needed, the machine direction strength of kraft paper may be increased during the drying stage of the papermaking process. This extensible kraft paper absorbs more shock without rupturing and it is primarily used in multiwall shipping sacks.

Multiwall shipping sacks are made up of two or more plies of kraft paper which can be combined with plies of plastic film or other barrier materials.

Typically, multiwall shipping sacks hold a minimum product weight of 25 lbs and are used to ship bulk products such as cement, chemicals and agricultural products. Multiwall sacks are a very economical packaging system. Since the layers of kraft paper and plastic film are lightweight, shipping costs are based essentially on product

U.S. STATISTICS FOR PACKAGING AND INDUSTRIAL CONVERTING PAPERS

	1988e	1987	1986	1985
Production[1], 000 short tons	5,110	5,068	5,117	5,205
Capacity[1], 000 short tons	5,662	5,592	5,758	5,985
Utilization rate, %	90.3	90.6	88.9	87.0
Imports, 000 short tons	335	310	243	172
Exports, 000 short tons	300	294	284	243
Apparent U.S. consumption				
000 short tons	5,145	5,084	5,076	5,134
lb/capita	41.90	41.80	42.60	43.20
000 tons/$ billion real GNP (1972)	3.00	3.03	3.11	3.21

1. American Paper Institute.

weight alone, and because the multiwall bag is flexible and strong, it can be stacked and pallet-loaded for shipment. Some smaller-sized multiwall bags are also used to package coffee, sugar, flour, pet food and charcoal briquets for consumer markets.

Merchandise bags are specialized types of bags commonly used by department stores and other retail businesses. Typically, these bags are bleached and printed. Bleached kraft papers which have been machine-finished (MF) or machine-glazed (MG) have an excellent glossy printing surface and are used to produce bags and wrapping papers for department stores and similar establishments where appearance is important.

The wrapping and other converting grades include a variety of specialty papers that are often lightweight (25-lb or below) and coated or laminated for moisture, vapor, or grease resistance.

INDUSTRY STRUCTURE

The structure of the packaging and industrial converting industry is fragmented because of the wide range of grades produced. Commodity unbleached kraft bag and sack paper grades are mainly produced at integrated mills in the southeastern U.S., which may also produce kraft linerboard on the same paper machines. Some unbleached kraft paper is also produced in the Pacific Northwest and in western and eastern Canada.

The top three commodity producers of unbleached kraft papers are Stone Container Corp., Union Camp Corp., and Georgia-Pacific Corp. In the Pacific Northwest, Longview Fibre Co., Port Townsend Paper Co. and Simpson Paper Co. are the key producers. These companies also produce more specialized unbleached and bleached packaging and converting papers.

Specialty and industrial papers are manufactured at small nonintegrated mills concentrated in the northeast and upper Midwest. James River Corp. is the major producer of these grades. Other producers of specialty papers include P.H. Glatfelter Co., Mosinee Paper Corp., CPM Inc., Wausau Paper Mills Co., Filtration Sciences Corp., Hollingsworth & Vose Co., and Dexter Corp.

Negative growth rates and low profitability in the unbleached kraft paper segment have caused a major industry restructuring through machine conversions and shutdowns and company divestitures. Stone has become the largest producer through its acquisitions of unbleached kraft mills formerly owned by Jacksonville Kraft Paper Co. and Continental Forest Industries Inc. Meanwhile, Champion International Corp., International Paper Co., and Georgia-Pacific have substantially reduced their market position in the industry by converting paper machines from unbleached kraft paper production to mostly kraft linerboard and uncoated free-sheet production.

In the specialty packaging and industrial paper sector, James River has expanded significantly over the past decade by acquiring a number of small nonintegrated specialty paper companies, including Riegel Products Corp. (1977), Brown Co. (1980), Premoid Corp. (1986), Specialty Paper Co. (1986), and Dunn Paper Co. (1987). James River also acquired specialty converting plants from H.P. Smith Paper Co. (1983), and Crown Zellerbach Corp. (1986).

Meanwhile, other companies sold or shut down their specialty paper businesses, including Bemis Corp. (1977-1986), Port Huron Paper Corp. (1983), and Philip Morris Inc. (1985). Thilmany Pulp & Paper Co. shut down two of its specialty paper machines in 1987.

SUPPLY/DEMAND TRENDS

Production of packaging and industrial converting papers has actually declined over the past 10 years. Shipments increased slightly from 5.7 million tons in 1977 to a peak of 5.8 million tons in 1979 and then declined to 5.1 million tons by 1987. This resulted in a negative growth rate of −1.2% annually over this period, compared with a positive 2.2% annual growth rate for all grades of paper and paperboard.

Most of the decline has come from grocery bag and sack paper grades, which have been displaced by plastic bags in about 30% of the country's supermarkets. Bleached packaging paper shipments have held relatively steady, while multiwall shipping sack papers have rebounded recently, following a 10-year decline. Competitive inroads by plastic films into many packaging markets, plus

U.S. TOTAL PRODUCTION AND CAPACITY OF PACKAGING AND INDUSTRIAL CONVERTING PAPER

(000 short tons)

	Production	Capacity	Utilization rate %
1987	5,068	5,592	90.6%
1986	5,117	5,758	88.9
1985	5,205	5,985	87.0
1984	5,551	5,991	92.6
1983	5,498	6,078	90.4
1982	5,300	6,076	87.2
1981	5,433	5,947	91.4
1980	5,327	6,072	87.7
1979	5,708	6,053	94.3
1978	5,778	6,146	94.0
1977	5,930	6,242	95.0
1976	5,661	6,202	91.3
1975	4,804	6,368	75.4
1974	5,732	6,360	90.1
1973	5,694	6,060	94.0
1972	5,706	6,028	94.7
1971	5,443	5,963	91.3
1970	5,438	5,940	91.6
1969	5,520	5,840	94.5

Sources: American Paper Institute, Bureau of the Census.

lackluster industrial activity in the early 1980s, have been mostly responsible for the poor performance.

Although kraft packaging and industrial paper production has dropped steadily, operating rates have remained close to 90% because of planned capacity reductions. Most of the decline in capacity has been concentrated in the unbleached kraft segment of the industry. This trend is expected to continue, but at a slower pace than in recent years. These scheduled capacity withdrawals, when combined with modest growth in production capacity for specialty papers, should keep average operating rates for the packaging and industrial segment above 90% for the next several years.

KRAFT PACKAGING PAPERS

U.S. unbleached kraft paper shipments peaked at 4.0 million tons in 1974, and then plummeted to 3.0 million tons by 1987. Most of the decline occurred during the past three years, as shipments declined nearly 650,000 tons between 1984-1987. Bleached packaging papers for the same end uses have remained relatively stable at around 480,000 tons.

Shipments of unbleached kraft paper grades in 1988 are expected to be about 7% lower than in 1987, mainly due to a further decline in demand for kraft grocery bag and sack papers. Demand for bleached and multiwall grades, which were strong in 1987, are expected to be somewhat weaker in 1988. Operating rates should remain above 90%, however, as producers continue "rationalizing" capacity between heavyweight grocery sack paper, lightweight linerboard, and bleached grades.

Since 1984, the industry has shut down about 550,000 tons of unbleached kraft paper production capacity, and shifted another 300,000 tons to kraft linerboard production. In 1984-1985, Georgia-Pacific shut down two machines at Crossett, Ark., with combined capacity of about 175,000-tpy, and converted production to uncoated free-sheet and bleached kraft paper grades. In 1985, G-P also converted a 158,000-tpy kraft paper machine at Monticello, Miss., to linerboard production. In 1985, International Paper shut down a 135,000-tpy machine at Mobile, Ala., for conversion to uncoated free-sheet and bleached kraft paper grades. In 1986, Champion International shut down its 236,000-tpy swing machine at Pensacola, Fla., for conversion to uncoated free-sheet. Additional conversions on a smaller scale were made during this period by other companies.

The most notable exception to this trend was Stone Container's reactivation of the former Jacksonville Kraft mill in 1987. Jacksonville's 125,000-tpy No. 1 machine is now producing 40- to 60-lb kraft sack and multiwall paper grades.

U.S. PRODUCTION AND CAPACITY OF PACKAGING AND INDUSTRIAL CONVERTING PAPER BY GRADES

(000 short tons)

	Unbleached kraft		Bleached kraft*		Special industrial paper	
	Production[1]	Capacity[1]	Production[2]	Capacity[1]	Production[2]	Capacity[1]
1987	3,075	3,370	1,023	1,101	1,043	1,122
1986	3,303	3,579	1,005	1,092	1,000	1,086
1985	3,403	3,808	995	1,104	966	1,074
1984	3,684	3,972	1,056	1,148	852	968
1983	3,666	4,065	902	1,119	804	894
1982	3,688	4,091	828	1,080	499	906
1981	3,881	3,991	923	1,091	485	865
1980	3,951	4,110	876	1,095	464	866
1979	4,096	4,098	993	1,105	531	850
1978	3,998	4,223	1,043	1,041	498	883
1977	3,936	4,317	1,002	1,069	524	856
1976	3,918	4,218	1,138	1,128	574	856
1975	3,374	4,333	965	1,194	440	841
1974	4,169	4,389	1,205	1,291	598	679
1973	3,902	4,138	1,205	1,292	610	629
1972	3,811	4,083	1,272	1,323	507	622
1971	3,649	4,031	1,242	1,383	438	549
1970	3,786	4,007	1,231	1,316	421	554
1969	3,780	4,006	1,297	1,275	443	559

* Includes glassine, greaseproof, and vegetable parchment.

Sources: 1. American Paper Institute; 2. Bureau of the Census.

Grocery bag and sack is the single largest end use market for unbleached kraft paper. Production of grocery bag and sack paper showed fairly steady growth during the first two decades after World War II due to the rapid growth of supermarket chains and the increased demand for large carryout sacks. By the 1970s, however, shipments of grocery bag and sack began to show signs of leveling off as population growth rates flattened and plastic bags began displacing kraft paper. The arrival of plastic grocery bags signaled the end of kraft paper's dominance of the carryout sack market.

Plastic's share of the grocery sack market rose from about 2% in 1976 to about 30% in 1987. The loss of market share relates to increasing cost competitiveness of plastic sacks in comparison to paper sacks. In 1976, a plastic sack was 110% of the cost of a paper sack; by 1980

ESTIMATED CAPACITY OF U.S. COMPANIES PRODUCING PACKAGING AND SPECIALTY PAPERS

	Annual capacity (000 short tons)	Grades
1. Stone Container[1]	773	Unbleached bag, sack, and converting
2. James River	535	Specialty packaging and industrial
3. Union Camp	450	Unbleached and bleached bag, sack, and converting and saturating kraft
4. Georgia-Pacific	340	Unbleached and bleached bag, sack, and converting
5. Longview Fibre	325	Unbleached and bleached bag, sack, and converting
6. Champion International	295	Unbleached and bleached bag, sack, and converting
7. Gaylord/Mid-America	270	Unbleached bag, sack, and converting
8. International Paper	260	Unbleached and bleached bag, sack, and converting
9. Gilman Paper	230	Unbleached and bleached bag, sack, and converting
10. Westvaco	200	Saturating kraft
11. Mosinee Paper	120	Specialty and industrial
12. Chesapeake	115	Unbleached bag, sack, and converting
13. Kimberly-Clark	115	Cigarette paper, specialty, and saturating kraft
14. Wausau Paper Mills[2]	105	Glassine, greaseproof, and specialty
15. Port Townsend	100	Unbleached bag, sack, and converting
16. P.H. Glatfelter[3]	90	Cigarette paper and technical specialty
17. Hammermill[4]	85	Specialty and industrial
18. Simpson Tacoma Kraft	80	Unbleached and bleached bag, sack, and converting
19. Fitchburg Paper[5]	70	Specialty and decorative
20. Willamette Industries	70	Unbleached bag, sack, and converting
21. Detroit River Paper[6]	60	Specialty and industrial
22. Consolidated Papers	55	Specialty packaging
23. Hollingsworth & Vose	50	Specialty and industrial
24. CPM	35	Specialty and industrial
25. Filtration Sciences	30	Specialty and industrial
26. Schoeller Technical	30	Photographic and technical specialty
27. Mead Specialty Paper	25	Technical specialty

Note: Exact capacities for packaging papers are difficult to estimate because of swing machines in the industry which can produce either linerboard or unbleached kraft packaging paper. Estimates for specialty and industrial papers are based on published sources and may not include some printing/writing paper, thin paper, or tissue tonnage.

1. Includes Seminole Kraft Corp.
2. Includes Rhinelander Paper Co.
3. Includes Ecusta Corp.
4. Includes Thilmany Paper Co. and Nicolet Paper Co.
5. Subsidiary of Rolland Inc. (Canada).
6. Purchased former Port Huron mill

the two products were at parity, and by 1987 the cost of a plastic sack was 60% that of a paper sack. Plastic penetration could reach 50% by 1990, spurred by the aggressive marketing and pricing of plastic sacks.

The improving cost competitiveness of plastic sacks has been made possible by new linear low-density (LLDPE) and high-molecular-weight high-density polyethylene (HMW-HDPE) resins, which have permitted converters to downgauge sacks and reduce their raw material costs. The first plastic sacks developed a decade ago were more than 2.0 mils thick, while today's sacks are in the range of 0.6 to 0.7-mil (see Plastic Resins section for more details).

The competition between paper and plastic grocery sacks has had little dampening effect on kraft paper prices because prices for grocery sack paper are influenced more by linerboard prices than by competitive plastic bag prices. Since some swing machines in the industry can manufacture either heavyweight grocery sack paper or lightweight linerboard, producers will allocate machine time with an eye toward which grade gives them a better return. According to an industry survey, about 1.0 million tons of kraft paper (mostly heavyweight grocery grades) were produced on 13 swing machines in 1986. About nine of these machines were mainly dedicated to linerboard, while four mainly produced kraft paper.

Most of these machines can make a better return producing lightweight liner in a strong linerboard market, so kraft paper prices must remain competitive with linerboard prices in order to maximize the mill's profits. As a result, the price of 70-lb grocery sack paper increased about 18% in 1986 and 16% in 1987, while 42-lb linerboard prices increased about 18% in 1986 and 34% in 1987. Prices of 70-lb grocery sack paper reached the $455 to $465/ton level during the second quarter of 1988.

The kraft paper price increases in 1986-1987 were not fully recovered by equivalent price increases for converted grocery bags and sacks, so profitability of converting operations has been poor in recent years. The competition from plastic sacks and the concentrated purchasing power of major supermarket chains has tended to keep the bag and sack price increases low. In early 1988, heavyweight paper grocery sacks were selling for $35 to $37/thousand vs $22 to $24/thousand for plastic grocery sacks. Imported plastic grocery sacks sell for as low as $16 to $17/thousand. The poor profitability of converting operations will likely result in a smaller and more consolidated industry with fewer independent converters.

A number of paper companies are hedging their bets by producing or marketing plastic bags in addition to paper bags and sacks. These companies include Union Camp, Georgia-Pacific, Champion International and converters such as Trinity Paper and Plastics Corp.

U.S. PRODUCTION OF PACKAGING AND INDUSTRIAL CONVERTING PAPER — BY END USE[1]

(000 short tons)

	Wrapping paper			Shipping sack paper			Bag and other paper			Other converting paper		
	Total	Unbl	Other[2]	Total	Unbl	Other[2]	Total	Unbl	Other[2]	Total	Unbl	Other[2]
1987	112	88	24	883	785	98	2,023	1,769	254	538	431	107
1986	117	93	24	831	747	84	2,314	2,050	264	526	412	114
1985	124	93	31	876	796	80	2,386	2,120	266	576	398	178
1984	135	97	38	968	878	90	2,543	2,284	259	591	405	186
1983	147	101	46	967	879	88	2,529	2,289	240	606	397	209
1982	138	93	45	973	895	78	2,433	2,211	222	547	364	183
1981	183	103	80	1,085	967	118	2,188	2,012	176	516	340	176
1980	240	137	103	1,154	1,062	92	2,330	2,101	229	670	419	251
1979	306	187	119	1,212	1,110	102	2,365	2,115	250	786	499	287
1978	365	210	155	1,111	1,019	92	2,365	2,092	273	815	551	264
1977	354	218	136	1,180	1,073	107	2,516	2,212	304	794	558	236
1976	321	195	126	1,228	1,100	128	2,428	2,154	274	902	499	403
1975	280	165	115	974	879	95	2,166	1,938	228	752	417	335
1974	369	226	143	1,409	1,279	130	2,134	1,889	245	980	535	445
1973	425	267	158	1,176	1,072	104	2,196	1,942	254	1,057	599	458
1972	498	294	204	1,101	996	105	2,183	1,942	241	1,142	694	448
1971	491	285	206	1,078	976	102	2,146	1,911	235	1,084	591	493
1970	518	298	220	1,094	996	98	2,117	1,898	219	1,088	596	492
1969	574	345	229	1,123	1,023	100	2,018	1,791	227	1,146	621	525

1. Excludes glassine, greaseproof, and parchment papers and specialty industrial papers.
2. Principally bleached kraft papers.

Source: Bureau of the Census (1981-87 based on shipments; prior years are for production).

U.S. EXPORT AND IMPORT TRENDS FOR PACKAGING AND INDUSTRIAL CONVERTING PAPERS

(000 short tons)

	Exports[1]	Imports
1986	284	243
1985	244	172
1984	284	145
1983	261	108
1982	263	80
1981	303	94
1980	331	86
1979	227	143
1978	173	138
1976	356	56
1974	340	142
1972	183	148
1970	188	64

[1] Includes special industrial paper and glassine, greaseproof, and parchment.

Sources: American Paper Institute, Bureau of the Census.

The outlook is for continued plastic growth at the expense of paper in the grocery sack market. Plastics penetration will probably reach 50% by 1990. Consequently, grocery bag and sack paper shipments are expected to decline 14% in 1987 and 16% in 1988.

Shipping sack is the second largest use after grocery bag and sack for unbleached kraft paper. Production peaked at the 1.0 million-tpy level in 1981, averaged about 880,000 tons per year in the 1982-1984 period, and plummeted to 747,000 tons in 1986. In 1987, production rebounded to 785,000 tons, and is forecast to reach 825,000 tons in 1988.

Multiwall paper shipments were up sharply in 1987 because of strength in agriculture and the construction and chemical processing industries, where multiwall sacks are used for shipping fertilizer, animal feed, seed, cement, plastic resins and other materials. The major competitive threat to shipping sacks has come from bulk handling and heavy-duty plastic shipping sacks, which have penetrated about 10% of the U.S. market. Most multiwall sacks, however, already incorporate a single barrier layer of polyethylene for moisture resistance and added strength.

A more significant reason for the decline in multiwall paper tonnage since 1981 has been the general reduction in the weight of paper used in multiwall sacks. The four basic weights of kraft paper used—40, 50, 60 and 70 lbs—have

U.S. PRODUCTION OF UNBLEACHED KRAFT PACKAGING AND INDUSTRIAL CONVERTING PAPERS

(000 short tons)

				Bag and sack[2]			Other converting[3]				
Year	Total	Wrapping[1]	Shipping sack	Total	Grocer	Other	Total	Asphalting	Other creping	Gumming	Other
1987	3,073	88	785	1,769	1,690	79	431	—	—	—	—
1986	3,302	93	747	2,050	1,960	90	412	—	—	—	—
1985	3,403	93	797	2,116	2,043	73	397	—	—	—	—
1984	3,683	97	883	2,292	2,203	89	411	—	—	—	—
1983	3,666	100	879	2,289	2,196	93	398	—	—	—	—
1982	3,563	93	895	2,211	2,127	84	364	—	—	—	—
1981	3,729	103	1,015	2,209	2,117	92	402	—	—	—	—
1980	3,852	137	1,062	2,269	2,168	101	384	176	40	63	105
1979	3,984	187	1,110	2,226	2,120	106	461	215	25	80	141
1978	3,900	211	1,019	2,225	2,121	104	445	173	22	61	189
1977	3,916	218	1,073	2,100	1,994	106	525	179	14	66	266
1976	3,815	195	1,100	2,106	1,966	140	414	167	6	68	173
1975	3,322	165	879	1,925	1,805	120	353	131	6	61	155
1974	4,079	226	1,279	2,131	1,974	156	443	134	13	83	213
1973	3,771	266	1,072	1,942	1,825	117	491	150	17	90	234
1972	3,825	294	996	1,942	1,854	88	593	165	25	96	307

[1] All colored or natural brown MF and MG, including treated and untreated butcher papers.
[2] Other than shipping sacks.
[3] Data not available or withheld for 1981-87.

Sources: Bureau of the Census, American Paper Institute.

different tear and tensile strengths, and generally the higher the weight, the greater the strength. But tear and tensile properties of kraft paper have been improving over the last decade, which has permitted more substitution of lighter-weight paper. For example, during the drying process the machine direction strength of the kraft paper can be substantially increased by compacting the sheet or by allowing the sheet to shrink. This extensible kraft paper can absorb more shock without rupturing than can conventional kraft paper.

Another improved air-dried multiwall kraft paper with greater strength and stretch was introduced by St. Regis Paper Co. in 1982. This Stress Kraft paper permitted sack converters to eliminate a ply of paper for a basis-weight reduction of at least 18% and get the same performance as with a regular sack. Unfortunately, converters were unwilling to pay a premium price for Stress Kraft and orders dried up during the country's economic downturn. Following Champion's takeover of St. Regis in 1984, production of Stress Kraft was phased out on the 240,000-tpy paper machine at Pensacola, Fla., by early 1986.

Normally, multiwall paper sells at a premium price because of its higher quality and strength requirements. However, when multiwall paper prices move up rapidly, some converters unwilling to pay the large premium will substitute some grocery paper for multiwall in sack plies. At the same time, weakness in heavyweight grocery sack prices will cause some producers to try to make multiwall paper. Prices for 50-lb multiwall paper increased about 11% in 1986 and 14% in 1987, and reached the $510 to $520/ton level during the second quarter of 1988. Higher prices are received for clay-coated or bleached multiwall paper.

The outlook for shipping sack paper shipments is more

U.S. PRICE TRENDS FOR SELECTED UNBLEACHED KRAFT PAPER GRADES

($/short ton)

Year[1]	Shipping sack +50-lb	Grocery sack +70-lb	Grocery bag & sack +30-lb
1987			
3Q	$455/485	$400/430	$595/625*
2Q	455	400	595*
1Q	455	400	595*
1986			
4Q	420/430	365/375	565
3Q	390	335/345	535
2Q	390	335/345	535
1Q	375/390	300/320	500
1985	375	288	441
1984	415	336	502
1983	395	250	—
1982	381	260	—
1981	401	305	—
1980	371	272	—
1979	328	243	—
1978	296	220	—
1977	288	199	—
1976	271	209	—
1975	266	220	—
1974	220	199	—

* Reflects discounting from list prices.

1. Annual average showed for years 1974 to 1985.

Source: *Pulp & Paper Pricebook 2.*

MAJOR U.S. UNBLEACHED KRAFT PAPER CAPACITY WITHDRAWALS

Completed	Mill	Capacity (short tpy)	Date
Gulf States Paper	Tuscaloosa, Ala.	167,000	1978
Crown Zellerbach	Bogalusa, La.	140,000	1979
Boise Southern	Elizabeth, La.	105,000	1981
Manville Forest	West Monroe, La.	35,000	1981
St. Regis	Lufkin, Texas	100,000	1981
Georgia-Pacific	Crossett, Ark.	175,000	1984-85
	Monticello, Miss.	158,000	1985
International Paper	Mobile, Ala.	135,000	1985
Champion International	Pensacola, Fla.	236,000	1986
Gilman Paper	St. Marys, Ga.	86,000	1988
Total withdrawals		1,337,000	

encouraging than it is for grocery bags and sacks. Shipments increased about 5% in 1987, and should match that rate again in 1988. Longer term, however, growth will average about 1% annually.

Other bag and sack paper is largely used for retail bags for bakery products, fast food chains, and department stores and has been in a long-term declining trend due to displacement by plastic bags. Paper garment bags were largely displaced by plastics in the 1960s and merchandise bags were the next to face plastics competition in the 1970s. With the introduction of low-cost high-density polyethylene resins, plastic merchandise bags have captured an estimated 75% of the market.

Paper manufacturers have given up these markets without much of a fight because the lighter-weight (typically 30 to 35-lb) and more specialized machine-finished and machine-glazed paper required to produce such bags has been less profitable to produce. The demand for these papers generally comes from up-scale department stores which use heavier-weight decorative paper merchandise bags to convey a quality image, and retail food stores which use lighter-weight bleached paper bags for their sanitary appearance.

Wrapping paper has also lost much of its market to plastic stretch and shrink films. Shipments of unbleached and bleached wrapping papers total about 100,000 tons annually. For the short term, further significant slippage in wrapping paper demand is not expected to occur, since most of the displacement has already occurred. The unbleached grades are mostly used for parcel post and industrial shipping, while the bleached grades are mostly used as butcher paper.

Other converting papers, both unbleached and bleached, account for about 500.000 tons annually. Most of these papers are coated, waxed, gummed, or laminated for use in a variety of flexibie packaging applications.

Demand for these papers declined in the 1970s as plastics claimed a large share of the flexible packaging market, but

U.S. PRODUCTION OF MAINLY BLEACHED PACKAGING AND INDUSTRIAL CONVERTING PAPERS[1]

(000 short tons)

			Shipping sack[3]			Other bag and sack			Other converting[4]		
Year	Total[1]	Wrapping[2]	Total	Sulfite, kraft	Other	Total	Grocer	Other	Total	Waxing	Other[5]
1986	616	33	173	162	11	204	142	63	—	148	57
1985	570	33	118	107	11	240	170	70	—	130	48
1984	555	50	113	92	21	209	137	72	183	132	51
1983	561	65	119	95	24	168	122	46	—	157	52
1982	497	66	105	—	—	143	105	38	—	136	47
1981	536	80	117	84	34	176	124	51	—	120	47
1980	574	103	92	—	—	229	155	73	150	98	52
1979	643	119	102	—	—	250	170	80	172	113	59
1978	711	155	92	—	—	273	217	55	191	76	115
1977	716	136	107	—	—	304	198	106	169	69	100
1976	852	126	128	29	99	274	153	121	324	117	207
1975	629	115	95	27	68	228	133	95	191	97	94
1974	774	143	130	39	91	245	144	101	256	117	139
1973	786	158	104	22	82	254	169	85	270	138	132
1972	849	204	115	23	92	241	168	73	289	141	148

1. Excluding unbleached, glassine, greaseproof, and parchment papers. Principally bleached kraft paper but can include sulfite and other-fiber-based papers.
2. Includes MG and MF wrapping papers and miscellaneous. MG/MF includes treated and untreated butcher papers.
MG/MF production: 1980, 95; 1979, 109; 1978, 127; 1977, 122; 1976, 109; 1975, 100; 1974, 121; 1973, 133; 1972, 171.
Misc. production: 1980, 8; 1979, 10; 1978, 28; 1977, 15; 1976, 17; 1975, 15; 1974, 22; 1973, 25; 1972, 33.
3. Includes combination kraft and rope, bleached and semibleached.
4. Over 18 lb. Production figures available in earlier years:
Envelope stock: 1976, 130; 1975, 99; 1974, 135; 1973, 130; 1972, 126.
Gumming stock: 1980, 32; 1979, 34; 1978, 23; 1977, 14; 1976, 12; 1975, 10; 1974, 11; 1973, 13; 1972, 13.
Twisting/spinning stock: 1974, 34; 1973, 35; 1972, 48.
5. Such as asphalting, creping stock, etc.

Source: Bureau of the Census.

the erosion has slackened in recent years. The outlook is for some gradual loss to plastic films for converted grades which are in direct competition with plastics.

One unique segment of the converting area that has been showing moderate growth in recent years is **saturating kraft paper**, which is used in making decorative laminates such as Formica. Although cyclical, demand for saturating kraft has had a long-term positive growth rate, and production in 1988 is estimated to be 300,000 to 350,000 tons. The two major producers of saturating kraft are Westvaco Corp.'s Charleston, S.C., mill, and Union Camp's Savannah, Ga., mill. In 1984, Union Camp completed a $27 million improvement on its saturating kraft paper machine; and in 1987, Westvaco also rebuilt a saturating kraft paper machine to increase capacity.

SPECIAL INDUSTRIAL PAPERS

Specialty industrial papers represent a unique segment of the paper industry. More than 300 different specialty papers are produced for industrial customers in the U.S. and abroad. These papers are generally used by industry for conversion into other products and require the blending of various fibers and chemicals, and special surface treatment or lamination with synthetic films, textiles or other materials. Industrial papers are generally produced to exact customer specifications and are used in the manufacture of automotive

AVERAGE VALUE OF U.S. EXPORTS AND IMPORTS FOR PARCHMENT, GREASEPROOF PAPERS, AND GLASSINE

($/short ton)

	Exports	Imports
1986	$2,385	$1,374
1985	1,551	1,390
1984	1,625	1,416
1983	1,067	1,453
1982	1,330	1,498
1981	1,187	1,686
1980	1,148	1,578
1979	1,008	1,020
1978	833	948
1977	807	879
1976	739	849
1975	445	872
1974	655	731
1973	651	616
1972	812	581
1971	727	417
1970	671	417

Source: Dept. of Commerce.

PRODUCERS OF VEGETABLE PARCHMENT, GLASSINE, AND GREASEPROOF PAPERS

	Location	Grades	Capacity[1] (tpd)
1. James River Corp.			
Riegel Products Div.	Milford, N.J.	Glassine, greaseproof	100
KVP/Dunn Paper Div.	Parchment, Mich.	Vegetable parchment	120
2. Wausau Paper Mills Co.			
Rhinelander Paper Co.	Rhinelander, Wis.	Glassine, greaseproof	150
3. Hammermill Paper Co.			
Nicolet Paper Co.	De Pere, Wis.	Glassine, greaseproof	140
4. E.B. Eddy Forest Products	Espanola, Ont.	Vegetable parchment, greaseproof	140
5. Simkins Industries			
Westfield River Paper Co.	Lee, Mass.	Glassine, greaseproof	15
	Russell, Mass.	Glassine, greaseproof	50
Deerfield Specialty	Nixon, Ga.	Glassine, greaseproof	55
	Quebec, Que.[2]	Glassine, greaseproof	35
6. Domtar Inc.	St. Catherines, Ont.	Glassine, greaseproof, vegetable parchment	70

1. Capacity estimates may include tonnage of other specialty grades.
2. Subsidiary is Glassine Canada Inc.

U.S. PRODUCTION, EXPORTS, AND IMPORTS OF PARCHMENT, GREASEPROOF PAPERS, AND GLASSINE

(000 short tons)

	Production	Exports	Imports
1986	—	4	17
1985	—	6	16
1984	—	5	12
1983	209	17	8
1982	206	5	6
1981	176	9	5
1980	202	8	4
1979	234	8	5
1978	259	8	5
1977	219	5	3
1976	207	10	3
1975	191	11	2
1974	240	8	3
1973	230	4	3
1972	234	3	2
1971	206	3	2
1970	203	3	3
1969	216	—	—

Source: Bureau of the Census.

oil and air filters and other types of filters for consumer products, cigarette papers, sanding belts and other abrasives, masking tapes, engine gaskets, electrical insulators, pressure-sensitive release papers and many other industrial products.

Production of specialty papers has increased gradually since 1970 and currently totals about 600,000 tons, according to Bureau of the Census estimates. API shows capacity of about 1.0 million tons. However, since it is difficult to define these grades and to separate them from other converting grades, published capacity and production figures are not a good indication of industry trends. Some types of industrial papers have lost market share, especially in areas where plastic and synthetic products can substitute—such as nonwovens. Nonetheless, the overall demand for specialty grades continues to expand, with pressure-sensitive release papers and filter papers showing the best performance. In turn, the pricing for most specialty grades remains strong. Some specialty paper sells for as high as $8/lb (or $16,000/ton) in the U.S.

Specialty papers are typically produced by small, privately-held companies or divisions of larger paper companies at mills with capacities of 12 tpd to 50 tpd. Most of these mills purchase pulp from outside sources and may need as many as 10 to 20 different types of woodpulp, glass fibers, hemp fibers and other materials to produce specialty papers. A mill will often produce up to eight

U.S. PRODUCTION OF SPECIAL INDUSTRIAL PAPERS

(000 short tons)

Year	Total	Cable paper[1]	Electrical insulation[1,2]	Absorbent paper[1]			Matrix paper and board[1]	Vulcanizing-fiber stock[1]	Resin-impregnated stock[1]	Others[1]
				Total	Blotting	Filter				
1986	693	—	—	—	—	—	—	—	—	—
1985	668	—	—	—	—	—	—	—	—	—
1984	697	—	—	—	—	—	—	—	—	—
1983	804	—	—	—	—	—	—	—	—	—
1982	737	—	—	—	—	—	—	—	—	—
1981	485	—	—	—	—	—	—	—	—	—
1980	464	—	—	—	—	—	—	—	—	—
1979	531	—	—	—	—	—	—	—	—	—
1978	498	—	—	—	—	—	—	—	—	—
1977	561	10	20	74	3	71	*	18	89	276
1976	589	*	17	77	4	73	*	18	97	303
1975	472	3	14	61	3	58	2	12	76	243
1974	640	6	28	84	7	77	5	25	80	330
1973	643	5	29	72	9	63	7	28	113	317
1972	528	9	25	55	6	49	8	26	101	249

* Data withheld to avoid disclosing figures for individual companies.

[1] Data not available or withheld for 1978-86.

[2] Includes armature paper and paperboard.

Source: Bureau of the Census.

different grades of specialty paper per day on older machines which may have widths of 15 ft or less.

James River is by far the major North American producer of specialty industrial papers. Other notable producers include Filtration Sciences, Dexter, Mosinee, Hollingsworth & Vose, Glatfelter, CPM, Wausau, and Georgia-Pacific.

GLASSINE, VEGETABLE PARCHMENT, AND GREASEPROOF PAPERS

These specialized papers have smooth, glass-like surfaces and are transparent. They are mostly used for protective food and nonfood packaging, but other applications include drafting and graphic papers, windows of envelopes, and a wide variety of other applications.

Glassine is produced from sulfite pulp, beaten and refined to such a high degree that the pulp appears to be a dense, gelatinous mass. The high degree of fiber damage and collapse which results during pulping increases the fiber bonding area and makes the subsequently manufactured paper highly resistant to the passage of vapors, oils and grease. When waxed, lacquered or laminated, it is also impervious to moisture. Glassine paper is used as a protective wrapper for all kinds of foodstuffs and tobacco products, as well as for many purposes where its transparent feature is useful.

Glassine is formed on a fourdrinier paper machine and is supercalendered to give the sheet a high gloss. Typical basis weights for glassine range from 15 to 40 lb (24x36 in., 500 sheets).

Vegetable parchment takes its name from its physical similarity to animal parchment. It is prepared by passing a sheet of cotton fiber or chemical woodpulp paper through a bath of sulfuric acid, followed by washing and drying. The resulting sheet has a "parchment" feel and appearance and is very durable and resistant to grease and other contaminants. The sheet has high wet strength and it may be waxed, coated, embossed or crinkled. As a printing paper, it is a high-quality sheet used for legal documents. The basis weights range from 24 to 40 lb. (17x22 in., 500 sheets). As a packaging grade, in various weights and degrees of translucency or opaqueness, it is used in wrapping frozen, moist, greasy or dry food products such as butter, meat, and poultry. Like cellophane and waxed papers, these papers have lost many of their traditional markets to plastic films. In 1980, production of these papers was reported by the Bureau of the Census to be about 200,000 tons. The figure may be half of that amount today. James River, Nicolet Paper Co., and Simkins Industries Inc. in the U.S., and E.B. Eddy Forest Products Ltd. in Canada are the remaining principal producers of these specialized papers.

CANADIAN KRAFT PAPER INDUSTRY

The Canadian kraft paper industry shares many of the same market conditions for its products as the U.S. industry. Domestic kraft paper consumption has gradually declined as plastic products have replaced paper bags and sacks in traditional end use markets. However, Canadian producers have offset these losses by increasing their export shipments of kraft paper to the U.S., particularly multiwall grades, due to the significant reductions in U.S. kraft paper capacity.

Production of bleached and unbleached kraft papers gradually declined from a cyclical peak of 637,000 metric tons in 1978 to 430,000 metric tons in 1984. By 1987,

ESTIMATED CAPACITY OF CANADIAN COMPANIES FOR KRAFT AND SPECIALTY PAPERS

(000) short tons

	Annual capacity	Grades
1. Eurocan Pulp & Paper Co.	130	Unbleached bag, sack, wrapping
2. Manfor Corp.	130	Unbleached bag, sack
3. Prince George Pulp & Paper	110	Bleached and unbleached sack, bag
4. Cascades	70	Unbleached and bleached bag, wrapping
5. Crown Forest Industries Ltd.	45	Bag, wrapping, converting
6. Eddy Forest Products Ltd.	45	Bleached bag, sack, converting, wrapping
7. Consolidated-Bathurst Inc.[1]	35	Unbleached bag, converting, wrapping, specialty
8. Domtar Inc.	30	Bleached and unbleached bag, sack, converting, wrapping
9. J. Ford	16	Kraft wrapping and specialty paper

[1] Has announced a shutdown for 1988.

however, production had rebounded to 567,000 metric tons. Operating rates also improved from a low of 77.4% in 1984 to a strong 97.1% in 1987.

The decline in domestic consumption of kraft papers has mostly affected the eastern Canadian mills, which were built to serve the domestic market and are not particularly cost competitive. The companies which have dropped out of the kraft paper business have been concentrated in the east, and include Great Lakes Forest Products Ltd., CIP Inc., Abitibi-Price Co., and Consolidated-Bathhurst Inc. The western Canadian industry, however, is highly export oriented and includes large, efficient mills operated by Canfor Corp., Eurocan Pulp & Paper Co. Ltd., and Manfor Ltd. All of these companies have constructed new mills with capacities in excess of 100,000 metric tpy during the past 10 years. The most significant potential development in this sector is the possible sale of Manfor, now owned by the Manitoba government, to the private sector. Domestic paper shipments have remained at about 240,000 metric tpy during the past five years. Plastics have captured about 60% of the Canadian grocery bag and sack market and about 40% of the shipping sack market. Although this market penetration is very uneven throughout the country, it is generally conceded that market losses will continue, albeit at a slower rate.

Exports of kraft paper have increased steadily from about 192,000 metric tons in 1984 to 320,000 metric tons in 1987. About 50% of the kraft paper exports are destined for the U.S. market, but nearly 100% of the converted kraft paper bags and sacks exported by Canada go to the U.S. Multiwall kraft paper and shipping sacks account for most of the export activity.

CANADIAN PRODUCTION AND CAPACITY FOR KRAFT PAPERS

(000 short tons)

	Production	Capacity	Utilization rate, %
1987	567	584	97.1%
1986	540	579	93.3
1985	486	541	89.8
1984	430	531	81.0
1983	475	554	85.7
1982	453	527	86.0
1981	516	566	91.2
1980	538	562	95.7
1979	606	617	98.2
1978	637	622	102.4
1977	546	621	87.9
1976	518	624	83.0
1975	422	641	65.8
1974	637	636	100.2
1973	616	602	102.3
1972	537	570	94.2
1971	492	—	—
1970	439	—	—
1969	451	—	—

Source: Canadian Pulp & Paper Assn.

TISSUE

Tissue falls into two major groups: sanitary and "other." About 98% of total output is sanitary, including bathroom, facial, toweling, napkins, basestock for sanitary stock, wadding, and wipes. The "other" group includes basestock for waxing, wrapping, and miscellaneous uses.

The two major markets for tissue are consumer and commercial and industrial (C&I). Consumer tissue is purchased by consumers at retail outlets, while industrial tissue is bought by hotels, offices, restaurants, factories, and institutions. Typical tissue basis weights include 12 to 14 lb/3,000 ft^2 for single-ply bathroom tissue and 32 to 39 lb/3,000 ft^2 for single-ply toweling.

OUTLOOK

Tissue demand in the U.S. is expected to decrease as population growth slows down, but industry sources predict that per capita tissue consumption will increase from 38.5 to 45.2 lb in the next decade.

U.S. tissue producers are operating in an extremely competitive environment. The operating rate has been increasing: 92.4% in 1985, 93.1% in 1986, and 94.8% in 1987. The rate is expected to remain around 94% to 95% in 1988, but then it should decrease to about 92% in 1989 when new capacity comes onstream. U.S. tissue capacity is expected to grow 3.0% in 1987, 2.4% in 1988, and 2.7% in 1989, according to the American Paper Institute's recent capacity survey. This works out to an average annual growth rate of 2.7% for 1987-89. However, these figures do not include the 80,000-tpy tissue machine that Chesapeake Corp. is installing at Wisconsin Tissue, Menasha, Wis., in 1990. Nor do they include Kimberly-Clark Corp.'s 68,000-tpy tissue mill under construction in Jenks, Okla.

Some observers fear that overcapacity may plague the industry in late 1989. Late in 1986, James River Corp. announced it was going to bring four tissue machines onstream in the next eight years, but the company has since revised it to three machines. Not all of that capacity will be new since some older machines will probably be retired. The first machine will be built at Clatskanie, Ore., in the Wauna Div. mill formerly owned by Crown Zellerbach Corp. The 70,000-tpy machine is slated to start up in second-half 1988 and will probably cost about $88 million, including converting lines. Another machine will probably be located in the Northeast, at either the former CZ mill in South Glens Falls, N.Y., or the Old Town, Maine, mill, which has excess pulp capacity.

Analysts estimate that Fort Howard Corp. is adding about 665,000 tons of capacity during the 1983-93 period, or more than half of the total tissue market's anticipated growth. On Mar. 28, 1987, the company started up the first of four tissue machines at its $1-billion Savannah River mill at Rincon, Ga. The machine has capacity for 250 to 400 tpd of facial and bathroom tissue and paper napkins and

U.S. STATISTICS FOR TISSUE

	1988e	1987	1986
Production, 000 tons*	5,426	5,341	5,095
Capacity[1]	5,771	5,635	5,472
Utilization rate, %	94.0	94.8	93.1
Imports[2]	50	55	66
Exports[2]	38	36	17
Apparent U.S. consumption	5,350	5,298	5,144
lb/capita	43.6	43.6	42.7
GNP ratio (000 tons/ $ billion real GNP)	1.39	1.39	1.39

e = Estimate.

* All tons are short tons.

1. American Paper Institute data.

2. U.S. Dept. of Commerce data.

towels, depending on which grade is being produced. The second machine started up Mar. 28, 1988, and it has the same capacity as the first. The third machine is expected to start up in late 1989. Although the startup date for the fourth machine has not yet been announced, it is expected to come online by 1992, giving the mill capacity for about 1,500 tpd of tissue. Additionally, Fort Howard is installing a second air-laid tissue line at its Green Bay, Wis., mill.

Fort Howard is indisputably the leader in the C&I tissue market. However, some of the output from the Savannah River mill is ending up in the consumer market. George Adler, an analyst with Smith Barney, Harris Upham & Co., noted that such Fort Howard products as Mardi Gras napkins, Pomettes tissues, and Preference napkins are already encroaching on the lower end of the consumer market. Other industry observers note that the startup of the mill is pushing some tissue into western markets, making those markets even tighter.

The volume growth rate of the C&I sector has declined from 6% in the 1970s to about 3% in 1987. Fort Howard cannot grow faster than the market for much longer, so it will probably shift more production to the consumer market.

Producers of away-from-home tissue products implemented two price increases during 1987: a 6% hike in April and a 5% increase in November. Prior to that, a C&I price increase had last occurred in August 1986. The hikes were successful because demand was strong, and tissue makers needed to pass on the rising cost of wastepaper and especially market pulp.

Although producers of consumer tissue have also been suffering from rising market pulp prices, they have been less successful in passing on these costs to consumers due to the highly competitive nature of their market. In late March 1988, James River announced it was leading an across-the-board price increase on consumer tissue products. Effective Apr. 1, the price of the company's toilet tissue rose 9.2%, towel prices increased 5.6%, and the price of napkins rose 5.0%. Prior to this, no major player in the consumer market had hiked prices on roll products in about seven years. Every April for the past three years, however, Kimberly-Clark has increased the price of its facial tissue.

U.S. SHIPMENTS AND CAPACITY OF TISSUE PAPER

(000 short tons)

	Production[1]	% change	Capacity[2]	% change
1990p	—	—	5,955	0.5%
1989p	—	—	5,924	2.7
1988e	5,426	1.6%	5,771	2.4
1987	5,341	4.8	5,635	3.0
1986	5,095	3.1	5,472	2.4
1985	4,941	0.4	5,345	1.3
1984	4,921	2.7	5,276	1.7
1983	4,792	7.9	5,190	1.3
1982	4,441	−1.7	5,125	1.8
1981	4,517	3.2	5,033	1.6
1980	4,375	−3.2	4,954	1.7
1979	4,521	7.3	4,870	4.8
1978	4,215	−1.6	4,644	2.1
1977	4,285	2.4	4,545	1.0
1976	4,184	5.2	4,500	1.5
1975	3,979	−2.6	4,432	2.5
1974	4,086	1.2	4,322	0.4
1973	4,039	1.6	4,303	−0.3
1972	3,977	3.8	4,318	1.7
1971	3,833	3.1	4,244	1.4
1970	3,718	3.0	4,185	8.1
1969	3,611	—	3,873	—
Average 1978-88		2.5%		2.4%

p = Preliminary.
e = Estimate.
1. Source: Bureau of the Census.
2. Source: American Paper Institute.

CANADIAN PRODUCTION AND CAPACITY FOR TISSUE AND SANITARY PAPERS

(000 short tons)

		Capacity	
	Production[1]	Sanitary papers	Other tissue
1990e	—	577	20
1989e	—	555	20
1988e	—	544	21
1987	466	535	21
1986	495	516	20
1985	476	509	20
1984	424	514	20
1983	411	495	20
1982	413	500	21
1981	430	474	21
1980	406	414	23
1979	399	401	23
1978	368	403	24
1977	342	404	22
1976	335	385	25
1975	283	372	28
1974	361	353	27
1973	324	349	23
1972	312	344	20
1971	289	—	—
1970	240	—	—
1969	281	—	—

1. Excludes special papers.

Source: Canadian Pulp & Paper Assn.

The increase is usually in the 5% to 6% range.

Consumer-tissue producers have their backs to the wall because consumers will not tolerate big reductions in sheet counts any more, so a successful price increase is the only way for them to pass on rising market pulp prices. Observers indicate that only Georgia-Pacific Corp. and Scott Paper Co. are fully integrated among major U.S. tissue companies, although most of them produce a large portion of their own pulp.

During the hiatus in which no price increases were announced on roll products, producers instituted de facto price hikes by reducing sheet counts or basis weights. One source estimated that consumer tissue producers have on average reduced sheet counts in bathroom tissue from 420 sheets in 1981 to about 280 in 1987—a 33% reduction. This translates into an annual price increase of at least 7%. For example, in first-half 1987, Procter & Gamble Co. said it reduced the sheet count of its White Cloud two-ply toilet tissue from 300 to 280 sheets "to adjust to current market conditions."

Price competition in the bathroom tissue market was particularly severe in 1987 due to Georgia-Pacific's introduction of Angel Soft tissue in spring 1987. G-P said this is the first premium brand to debut in the U.S. in more than ten years. G-P conducted extensive market surveys which indicated that consumers prefer premium tissue brands, and these products now make up between 50% and 60% of tissue sales. G-P also plans to upgrade its Coronet line of tissues, towels, and napkins. The company spent at least $20 million on advertising for its new tissue, forcing Procter & Gamble and Scott Paper to increase their advertising budgets, couponing, and give-away promotions.

A.C. Nielsen Marketing Research reported that total U.S. sales of toilet tissue in grocery stores amounted to $2.2 billion in 1987—an increase of 3% from 1986. Sales of paper towels amounted to $1.46 billion, a 2% rise. Facial tissue sales improved 5% from 1986 and amounted to $791 million.

In Canada, Scott Paper Ltd. commands about 30% of the market for household tissue, but this market is expected to grow by less than 5% in 1987. The C&I market is expected to maintain its 7% growth level, so more production may be swung to this area.

Shakeout in Europe. Increasing consolidation is occurring in the European tissue market. In the middle of 1987, James River announced it would purchase 50% of the Kaysersberg Div. of French papermaker Béghin-Say for $243 million. James River will buy the sanitary paper and nonwovens division in stages through Jan. 30, 1989, but it gets 50% representation on Kaysersberg's board when it bought the first shares.

The company which owns Béghin-Say, Ferruzzi Agricola Finanziaria SpA of Italy, will also give Béghin-Say an option to sell James River an additional 17% of Kaysersberg for $126 million. The option must be exercised in three years. Kaysersberg had annual sales of $648 million in 1986 and net income of $17.8 million, and it is France's leading sanitary paper producer. The French

U.S. PRODUCTION OF TISSUE PAPER, EXCLUDING SANITARY AND THIN PAPER

(000 short tons)

Year	Total tissue paper[1]	Wrapping tissue	Waxing tissue stock	Twisting tissue stock	Creped wadding[2]	Other tissue paper
1986	130	59	(D)	—	(D)	23
1985	126	56	(D)	—	(D)	23
1984	136	69	(D)	—	(D)	31
1983	110	(D)	(D)	—	(D)	20
1982	106	(D)	(D)	—	(D)	21
1981	114	(D)	(D)	—	(D)	25
1980	176	72	24	13	25	18
1979	198	63	31	14	41	21
1978	210	74	32	12	37	29
1977	197	74	28	9	35	28
1976	193	61	37	8	30	30
1975	178	47	39	7	34	22
1974	224	44	49	10	46	41

(D) = Data withheld to avoid disclosing figures for individual companies.
1. Excluding sanitary and thin.
2. Creped wadding for interior padding.

Source: Bureau of the Census.

government must approve the sale.

James River characterized the purchase as a "cornerstone for European expansion" and said that it plans a major expansion of Kaysersberg's operations. Béghin-Say has some expansion plans of its own. In early 1987, the company announced it would raise $200 million in capital, about 33% of which will be used by Kaysersberg to buy tissue and hygienic products operations in Europe. Reportedly, the Kaysersberg Div. would buy both primary production facilities and converting plants in the European Economic Community (EEC).

One of the first acquisitions the division made was the purchase of Mira Lanza of Italy in early 1988. Mira Lanza is said to be Italy's second-largest paper converter, after Scott Paper, with 15% to 20% of the market. Kaysersberg said that in order to secure paper supplies for Mira Lanza it would either build or buy a new tissue machine. Mira Lanza is headquartered in Genova and has five converting plants.

Kaysersberg's nonwovens group will also mesh nicely with James River's product line. Kaysersberg makes, converts, and sells baby and adult diapers, diaper liners, sanitary napkins, place mats, towels, wipes, and a variety of medical products.

The Béghin-Say/James River move is symptomatic of a restructuring of the European tissue market that is squeezing out the medium-size producers, leaving only a few major producers and many small mills that make lower-grade tissue for local markets. European tissue producers are jockeying for position in a market that has been suffering from oversupply for several years. Supply and demand are not expected to come into better alignment before the mid-1990s.

Scott Paper, the largest tissue maker in Europe with about 25% of the EEC market, announced in late 1987 that it would invest $250 million in its sanitary-paper business in Europe over the next three years. It will build additional mills in France, Italy, and Spain. It is estimated that western Europe's sanitary-paper capacity needs will grow by 330,000 metric tons by 1991, and Scott plans to have a 60% share in that growth.

Scott secured some of its pulp supply in mid-1987 when it bought ENCE's (Empresa Nacional de Celulosas SA) 100,000-metric-tpy market pulp mill in Miranda del Ebro, Spain. Shortly after, Scott revealed that some of the pulp will supply two new tissue machines, the first to come onstream in 1989. Scott previously announced plans to start up a 60,000-tpy tissue unit in Paris during the same year. It is expanding tissue output at its Duffel, Belgium, mill by about 15,000 tpy to come onstream in second-quarter 1988. Plus, Scott became sole owner of Bowater-Scott Corp. Ltd. in the U.K. in 1986 and plans to start up two tissue machines there by 1990.

The same consolidation can be seen in Scandinavia. MoDoPapper AB of Sweden sold its tissue group (with capacity for 120,000 tpy of tissue products) to Holmens Bruk AB, also of Sweden, in mid-1987. This makes Holmen the third-largest tissue producer in Europe. (PWA AG of Fed. Rep. Germany is second.) In early 1988, however, MoDo bid $1.03 billion for a controlling interest in Holmen and Iggesund AB. Meanwhile, Mölnlycke AB,

U.S. PRODUCTION OF SANITARY TISSUE

(000 short tons)

Year	Total sanitary paper	Toilet tissue Total	Toilet tissue Single-ply	Toilet tissue Multi-ply	Facial tissue	Napkin Total	Napkin Single-ply	Napkin Multi-ply	Toweling[1]	Sanitary napkin wadding	Wiper stock[2]	Other sanitary stock
1986	4,503	1,786	1,105	681	301	595	431	165	1,593	(D)	117	111
1985	4,494	1,833	1,198	635	302	596	451	144	1,521	(D)	111	131
1984	3,953	1,489	955	534	285	529	400	128	1,363	73	108	104
1983	4,337	1,742	941	802	292	594	467	127	1,449	99	60	99
1982	4,185	1,679	962	717	277	532	407	125	1,433	113	56	94
1981	3,917	1,533	944	588	298	474	341	133	1,253	116	129	114
1980	4,298	1,706	939	766	370	532	409	123	1,439	—	251	—
1979	4,403	1,772	978	794	376	533	404	129	1,482	86	240	—
1978	4,036	1,629	939	690	383	429	317	116	1,376	73	57	76
1977	4,045	1,605	877	729	365	370	353	117	1,388	73	48	96
1976	3,936	1,578	933	645	359	448	342	106	1,335	53	52	90
1975	3,669	1,422	828	594	374	436	334	102	1,230	69	62	89
1974	3,799	1,415	834	581	395	439	345	93	1,308	—	55	119

(D) = Data withheld to avoid disclosing figures for individual companies.
1. Excludes wiper stock but includes facial tissue stock for towels.
2. Regular, facial, and wadding type.

Source: Bureau of the Census.

also of Sweden, was stepping up investments in its converting and distributing outlets throughout Europe. In early 1988, the company agreed to buy Peaudouce of France for about $344 million, essentially creating a pan-European supplier of disposable hygienic products.

MARKETS

Sanitary tissue represents about 98% of the tissue industry, and toilet tissue and toweling each make up about a third of the total sanitary and nonsanitary tissue market. These and other sanitary-tissue products are converted by the paper manufacturer and sold as finished goods in cases. Very little tonnage is sold as parent rolls to nonpapermaking converters that make them into finished products.

Most consumer tissue products are sold under brand names of major companies, with the most significant players being Procter & Gamble, Kimberly-Clark, Scott Paper, James River, Georgia-Pacific, Johnson & Johnson Corp., and Tambrands Inc. Branded products represent about 80% of retail tissue sales, with the other 20% being "generic" and "private label"—predominantly store brands.

Private-label and generic products. Pope & Talbot Inc. controls about 20% of the U.S. private-label market and wants to command a bigger share. The company led a 6% price increase on private-label tissue products in December 1987. In November 1987, it raised the price of its disposable diapers by about 7%. P&T is building a plant in the Atlanta, Ga., area that will have four lines: two for adult incontinence products and two for private-label disposable diapers. The plant is expected to start up in second-half 1988. P&T currently produces disposable diapers at its Eau Claire, Wis., mill.

Unit sales of private-label paper products, such as towels, bathroom tissue, napkins, and facial tissue, increased about 7% in 1986, reported *Private Label* magazine in its March 1987 issue. Margins for national brands were about 2%, while private-label products had gross profit margins between 8% and 11%. The most popular additions to private-label product lines include three-pack paper towels, followed by upright facial tissue boxes, pocket-pack facial tissue, six-roll bathroom tissue, and eight-roll bathroom tissue.

Sheet count reductions are endemic in both store and national brands. *Private Label* reports that most chains have reduced the standard counts of their private-label facial tissue from 200 to 175. Square footage of most paper towels has been declining, with some brands now at 70 ft^2. Generic towels are at about 60 ft^2. *PL* notes that four-pack two-ply bathroom tissue now contains about 350 sheets, while single-ply four-pack tissue has about 400 sheets.

The U.S. consumer is becoming disenchanted with generic brands of towels and tissue. Sales of generic paper products have fallen from 12% in 1980 to about 6%. Most chains are dressing up their black and white generic product lines in colored packages and selling them as private-label items. This often involves improving the quality of the product as well.

Single-pack two-ply paper towels enjoyed the best sales in the private-label category during 1986, reports *PL*.

U.S. TISSUE EXPANSIONS

Startup year	Company	Mill	Annual capacity (short tons)
Announced			
Apr. 1987	Fort Howard	Rincon, Ga.	88,250
Early 1988	Fort Howard	Rincon, Ga.	88,250
Late 1989[1]	Fort Howard	Rincon, Ga.	n.a.
n.a.	Fort Howard	Green Bay, Wis.	n.a.
Late 1988	Tagsons Papers	Mechanicville, N.Y.	n.a.
Late 1988	James River	Clatskanie, Ore.	70,000
Early 1988[2]	Georgia-Pacific	Palatka, Fla.	35,000
1990	Kimberly-Clark	Jenks, Okla.	68,000
Late 1990	Wisconsin Tissue	Menasha, Wis.	80,000
n.a.	Atlas Paper Mills	Hialeah, Fla.	n.a.
n.a.[3]	American Tissue	Natchez, Miss.	n.a.
Proposed			
n.a.[4]	James River	n.a.	n.a.

n.a. = Not available.

1. Capacity of third and fourth machines at Rincon have not been announced.
2. Incremental capacity expansion from rebuild.
3. Conversion of Diamond International Corp.'s idle molded pulp mill.
4. James River will start up two new tissue machines between 1989 and 1994; some will replace older machines.

About 82% of food-store chains said their sales in this category increased in 1986. Store-brand single-pack one-ply towels were a close second.

Commercial and industrial tissue. The tissue industry has been restructured as a result of James River's purchase of Crown Zellerbach. In the C&I tissue sector, Fort Howard ranks first with 31% of the 1.6-million-tpy market, followed by James River with 26% and Scott with about 9%. The dominant consumer grade is bathroom tissue, but in the C&I sector toweling is the big commodity.

Other tissue includes a small but important group of specialty grades used for wrapping, cushioning, packaging, and packing. Wrapping paper is the most significant grade in this category. Producers of these grades typically use small, old machines on which they can also make industrial wipes, but they cannot compete in consumer-tissue markets. As specialty-tissue makers, they can often operate profitably within a narrow niche so long as they can pass on increased raw material and manufacturing costs.

TECHNICAL DEVELOPMENTS

Basically, two types of sanitary-tissue products are offered: high-priced, high-performance products and lower-priced, conventional sheets. The high-priced category is made using low-density forming techniques that yield substantial reductions in fiber costs per case of tissue. Low-density forming avoids conventional pressing to retain fiber quality and texture, increasing the load on the dryers, so the reduction in fiber costs is offset by increased energy costs.

In the conventional tissue-making process, water is removed on either a short fourdrinier (usually a suction breast roll unit, often with an inclined table) or a twin-wire former to output a cohesive fiber web. Tissue formers and presses have evolved considerably during the past ten years, with major gains being made in runability and speed.

Concomitant with a speed increase of about 1,500 fpm are better formation, lower tensile ratio capability, and greater ease of operation. To overcome the speed and tonnage restrictions of the suction breast roll formers of the 1960s and 1970s, all new machines installed since 1975 have been twin-wire formers. Two types are available: C-wrap and S-wrap.

After exiting the former, the fiber web is usually dried on a yankee dryer, from which it is creped off and guided onto conventional dryers or to a winder. This yields a high-density web. Drying using yankee hoods is achieved through a connective heat transfer process in which a wrap of perforated nozzle boxes blows hot air (to about 950°F) with high velocity (to about 30,000 fpm) on the paper web.

Production increases on existing machines are usually a result of hood rebuilds. Yankee hoods have been developed to the point where they can handle about 80% of the drying load. To avoid compaction of the sheet at the yankee dryer, however, through-drying techniques are used before and after the dryer. Overall wet-end design evolution and the advent

ESTIMATED CAPACITIES FOR TISSUE OF MAJOR PRODUCERS

(000 short tons)

	Annual capacity				
	U.S.	Share of U.S. capacity (%)	Canada	Share of Can. capacity (%)	Company total
1. Scott Paper Co.	1,050	18.2%	165	30.8%	1,215
2. James River Corp.	1,041	18.0	—	—	1,041
3. Procter & Gamble Co.	900	15.6	—	—	900
4. Fort Howard Corp.	800	13.9	—	—	800
5. Georgia-Pacific Corp.	537	9.3	—	—	537
6. Kimberly-Clark Corp.	430	7.5	56	13.5	486
7. Erving Paper Mills[1]	150	2.6	—	—	150
8. Pope & Talbot Inc.	148	2.6	—	—	148
9. Chesapeake Corp.	120	2.1	—	—	120
10. APL Corp.	95	1.6	—	—	95
11. Dominion Cellulose[2]	—	—	94	17.5	94
12. Potlatch Corp.	89	1.5	—	—	89
13. Marcal Paper Mills Inc.	88	1.5	—	—	88
14. Eddy Forest Products	—	—	78	14.6	78
15. Statler Tissue Corp.	58	1.0	—	—	58

U.S. annual capacity (1988): 5.771 million tons
Canadian annual capacity (1988): 0.535 million tons

1. Sale of Lockland, Ohio, mill pending.
2. Subsidiary of CIP Inc.

of superwide machines have boosted production capabilities to 250 tpd on lightweight tissue and to 500 tpd on towels, even on the same machines.

There has been an acceleration in the development of new technology in recent years. Beloit Corp. has announced a new type of tissue former. Previously the exclusive patented property of Kimberly-Clark, the former is described as a twin-fabric former. With this design, the pickup felt wraps the forming roll much like the inside wire or fabric of a twin-wire former. A forming fabric wraps the forming roll as an outside drainage fabric. The headbox is mounted above the forming roll and discharges into the converging nip of the outside forming fabric and the pickup felt as they begin to wrap the forming roll.

Beloit says that the term "Crescent Former" is a good way of defining the shape of the forming zone. The unit is said to offer the product advantages of twin-wire forming without the capital outlay and operating costs of a second wire section. The sheet is formed directly on the felt, eliminating the usual transfer of the sheet from the wire section to the press section. The company said this is an advantage when making lightweight sheets because no sheet degradation occurs as a result of pickup.

U.S. TISSUE PRICES

(BLS price index)

	Sanitary paper stock[1]	Sanitary tissue health products[1]	Converted sanitary papers & health products[2]
1987			
4Q	113.6	107.0	387.3
3Q	113.6	106.9	386.6
2Q	113.0	106.1	384.1
1Q	110.7	106.6	385.0
1986			
4Q	111.1	106.2	382.7
3Q	109.5	106.2	383.0
2Q	108.9	106.2	382.5
1Q	108.0	106.2	380.9
1985			
4Q	107.8	106.1	379.9
3Q	107.4	105.8	378.6
2Q	106.8	105.0	375.8
1Q	106.8	105.1	373.9
Year-end			
1984	107.5	104.4	371.0
1983	102.5	99.9	359.7
1982	—	—	361.0
1981	—	—	348.4
1980	—	—	338.8
1979	—	—	291.0
1978	—	—	264.3
1977	—	—	240.7
1976	—	—	223.5
1975	—	—	201.7
1974	—	—	181.1
1973	—	—	127.3
1972	—	—	121.5
1971	—	—	119.9
1970	—	—	121.4

1. June 1983 = 100.
2. 1967 = 100.

Sources: U.S. Dept. of Labor, Bureau of Labor Statistics, Producer Prices and Price Indexes.

The first delivery of the new former was made to American-Israeli Paper Mills' No. 3 machine at Hadera in Israel. It has been redesigned to incorporate many of the features of twin-wire formers. The headbox will be a Thin Channel Concept III Converflo unit.

Multilayering gains importance. During the last ten years, multilayering of tissue and toweling has become an important tool for the papermaker. In multilayering, the headbox separates the jet into layers of different furnishes. This permits sheet bulk to be increased, lowering sheet count per roll. Multilayering makes it possible to design a sheet to best suit the papermaking process and the finished product. An obvious application is improving softness by putting a soft fiber on the sheet surface.

Softness is enhanced by chemically modifying the web. Several chemicals modify fiber-to-fiber bonds, improving softness. Also, embossing, calendering, or creping paper webs from an adhering surface with a creping blade will produce a softer sheet, but this is often done at the expense of breaking fiber bonds. Tissue makers are finding that variations of these methods provide softness without risking web integrity.

Escher Wyss has developed the Stepflow M headbox for this purpose. The company outlines the technological challenge of multilayering as follows: A layer of 6 to 7 g/m^2, generally required as minimum layer basis weight, results in a thickness of 20 M. Minimum mixing between the individual layers is necessary for both economic and quality advantages. The Stepflow M headbox incorporates two or three independent headboxes into one integrated unit. Each of the headboxes has separately adjustable slice opening and jet velocity. Different jet velocities for the individual layers give better formation and layer purity.

Regarding layer purity and creping behavior, Escher Wyss says that for one-sided dewatering the tissue maker should have a choice between two forming systems. One forming system should work so that the drainage-side layer comes into contact with the yankee cylinder surface, whereas with the second system the drainage-side layer should be oriented to the hood side. In this case, Escher Wyss uses a Tisco Former C-wrap instead of S-wrap as the forming section.

Valmet-KMW also stresses multilayer technology as a means of improving both quality and raw material utilization. In its approach to HTB-2L and -3L (for two and three layers), the company uses air wedge technology to separate the different headbox jets. This is said to improve separation between the layers of the tissue sheet.

Process control of tissue making is also developing quickly, with new techniques for measuring basis weight and moisture content of thin sheets being implemented.

Two problems facing the process control companies in this respect are variations in temperature and levels of dust. U.K. company Bristol Babcock has developed a system called Abacus II, in association with Celtona BV's paper mill in the Netherlands, which is said to be capable of measuring web properties accurately without being disturbed by environmental factors.

Air-laid forming. Air-laid lines are carving themselves a larger niche in the U.S. consumer absorbent products market. (Most air-laid tonnage is still made in Europe.) While machine speeds are relatively slow, air-laid forming requires about 40% less energy than wet forming. Plus, line cost is lower, so production facilities can be located closer to markets.

Air-laid paper webs are bonded by using either binders, such as latex, or heat and pressure methods, such as thermal bonding. This kind of web is well suited to towel products because of its high absorbency, reduced sheet count and low fiber weight per roll, and superior strength. However, wet forming can generally provide a more uniform product. A big portion of air-laid pulp fabric made in the U.S. now goes into household roll towel and industrial wipe applications. These two markets are served by James River and Fort Howard, both of which have large operations in Green Bay, Wis. Reportedly, demand is far outstripping supply. A few firms (e.g., Scott and Johnson & Johnson) have developed internal air-laid capacity.

In contrast, air-laid forming has not made many inroads in the production of facial and bathroom tissue, mainly because machine speeds are too slow to compete with conventional tissue machines.

At the end of 1986, Bridgewater Manufacturing Corp.'s plant in Bound Brook, N.J., started up the newest air-laid pulp line in the U.S. Supplied by Dan-Webforming of Denmark, the line uses a perforated roll-type former to deposit fibers on a web, which can be embossed and then bonded with latex resin. The system uses roll pulp, which is fluffed before being conveyed to the forming section. Bridgewater and its parent company, Hosposable Products, make baby diapers, adult incontinence briefs, pads, wipes, and other medical and personal-care products. Early in 1987, the company announced that it was planning to install a second air-laid line.

U.S. MARKET INDICATORS FOR TISSUE PRODUCTS

(billions of units)

Year	Facial tissue (two-ply)	Disposable household towels (jumbo rolls)	Bathroom tissue (rolls)
1987	196	2.5	9.1
1986	194	2.4	8.7
1985	190	2.4	8.6
1984	191	2.3	8.1
1983	190	2.2	7.7
1982	188	1.9	6.9
1981	183	1.8	6.6
1980	179	1.8	6.7
1979	181	1.7	6.6
1978	181	1.6	6.5
1977	180	1.5	6.3
1976	182	1.5	5.8
1975	177	1.4	5.3

Source: Kimberly-Clark Corp.

Duni Bila AB also started up an air-laid line late in 1986 at its plant in Halmstad, Sweden. Duni's 2.0-m-wide line is capable of producing about 1.1 metric tons/hour of material in the range of 50 to 120 g/m^2.

DIAPERS, INCONTINENCE PRODUCTS, WIPES

Use of superabsorbents in disposable diapers is increasing rapidly. "In Japan and the U.S., there is no turning back to pulp-only now. We expect less than 15% of U.S. diapers will be fluff pulp-only by 1990," said James Hanson, director of Marketing/Technology Service Inc., at "Insight '87" in spring 1987. Hanson said the Japanese market is already moving on to "generation-three and -four designs."

"Cutthroat" is an accurate way of describing the U.S. disposable-diaper market. In mid-1987, Kimberly-Clark and Procter & Gamble met in court to settle the question of which one had the right to use heat-shrinkable materials in the waistband of disposable diapers. P&G alleged that it held the exclusive patent to the technology for constructing the waistband, but a court ruled against the company. Meanwhile, K-C planned to pursue its suit against P&G, alleging that P&G "unlawfully monopolized the market for disposable diapers."

K-C's share of the $3.3-billion U.S. disposable-diaper market was about 31% at the end of 1987, up 2% from fall 1986. P&G's Pampers also had 31% while its Luvs commanded about an 18% share. Both companies recently fired new salvos in the war. P&G introduced a new version of Pampers, called Ultra-Plus, on Aug. 24, 1987. The product, which contains 21% superabsorbent material (and less fluff pulp) vs Ultra Pampers' 14%, will replace the current Ultra diaper in most markets.

The announced redesign closely followed P&G's introduction of a superthin diaper called Luvs Deluxe. This diaper has superabsorbents and replaced Luvs Super Baby Pants nationwide. Most analysts agree that these two moves indicate P&G will be aggressive in trying to regain market share.

Meanwhile, K-C was in the midst of a national rollout of significantly improved Huggies Supertrim dry-touch diapers. These diapers have an additional sheet of nonwoven material inserted between the diaper's liner and its superabsorbent material. The extra layer is said to draw fluid through the liner faster. This diaper needs less superabsorbents.

Paradoxically, part of the competitive nature of the market is due to the success of disposable superabsorbent diapers. Infants wearing the diapers require fewer changes.

Also, the birthrate in 1986 declined 0.5% in 1986 and rose less than 1% in 1987. In addition, while disposable products are uniquely suited to U.S. consumer habits, some of them contain nonbiodegradable components that add to pollution problems. Some state environmental groups are questioning the safety of these products.

Early in 1986 in a move that surprised most market observers, Weyerhaeuser Co., the leading U.S. supplier of private-label disposable diapers, introduced its first branded diaper at 10% below the cost of more popular brands. First Choice diapers will be sold in the Southeast before going national. They will be priced between private-label diapers and P&G's Pampers and Luvs diapers and K-C's Huggies.

In Europe, "ultra-diaper warfare" was on the agenda for 1987 and 1988, and Hanson hinted at the imminent launch there of two new superabsorbent diapers. For producers, 1987 was a key year in which to carve out market share in Europe. This was particularly true of France, which is the major European market for superabsorbent diapers.

The $645-million Japanese disposable diaper market is growing at about 30%/year and is expected to be worth about $1.3 billion by 1990, according to some estimates. It is even more inviting when one considers that while about 80% of babies in the U.S. and Europe wear disposable diapers, only about 30% of babies in Japan use them. Procter & Gamble formerly controlled about 90% of the Japanese diaper market, but by 1985 its share had fallen to around 7%. Once P&G had introduced its superabsorbent diaper into the market, its share rose to 15%.

Currently, around 50% of the Japanese diaper market belongs to two domestic companies: Uni-Charm Corp. and Kao Corp. Shiseido Co. is introducing a new diaper and hopes to capture over 10% of the market in the next five years. All of this has led some observers to predict that a price war will soon be waged in the Japanese diaper market. In late 1986, most major producers participated in extensive promotion programs.

In September 1987, Oji Paper Co. Ltd. joined the fray by introducing its Do Re Mi diapers. Nationwide distribution was expected by spring 1988. Distribution will be done by Oji Tissue Sales. Oji hopes its new entry will eventually garner 20% of the diaper market. These plans will conflict with Uni-Charm's forecast for its new Ultra Moony baby diapers, which it introduced in 1987. Uni-Charm anticipated that its new diapers would capture half the domestic market in 1987, and ten patents were applied for worldwide.

Adult incontinence products is the new growth area for consumer absorbent products. At the Impact '88 nonwovens conference held in March 1988, analyst Jeanne J. Carroll of Morgan Stanley & Co. cautioned that the market is poorly understood and that projections of potential market size are unrealistically high. In 1987, total U.S. manufacturers' sales were an estimated $350 million, of which about 60% was to the institutional market. She estimated that the unit growth rate in the institutional market will be 5% annually through 1990.

Carroll estimated that sales of incontinence products for the at-home market reached $130 million in 1987. By 1992, sales could possibly reach $450 million. The major players in this market are Procter & Gamble, Kimberly-Clark, and Johnson & Johnson

Wipes. While the U.S. market for wipes grew 50% between 1962 and 1987, paper's share declined by 7% to 23%, according to Julius C. Parrella, a marketing manager for Johnson & Johnson's Chicopee Div. The U.S. market for wipes was worth about $1.8 billion by 1987, and paper wipes (tissue: single- or multi-ply, with or without scrim reinforcement) accounted for $420 million of that pie. Paper and woven textiles have been elbowed out by nonwoven wipes (made from textile fiber, cellulose, or a combination), which commanded 30% of the market or $540 million, compared with just 9% in 1962.

Chicopee and Kendall Co. pioneered the nonwoven wipes market using dry-forming technology (mainly card and bind). The first significant consumer product came in 1967 with the introduction of Handi-Wipes, made by Chicopee and marketed by Colgate-Palmolive Co. Another important product came in the early 1970s with the debut of the first premoistened baby wipes.

A number of paper companies now produce nonwoven wipes, including Scott, International Paper Co., Fort Howard, James River, and Kimberly-Clark. In 1976, Scott introduced a dry-formed technology to make an industrial wipe called Wypall out of cellulose bonded with resin. More recently, Scott introduced its Sofkins line of wet bathroom wipes for adults. Sofkins were available in about half of the U.S. by mid-1987, and Scott planned to increase production by upgrading its Dover, Del., facility, which contains two dry-forming lines. Similar wet bathroom wipes have been studied or test marketed by P&G and a number of European and Japanese companies, but with only limited success.

Newer wipe developments include introduction of a fiber entangled fabric (spunlaces) by Chicopee and a 100% polypropylene meltblown fiber wipe by K-C (Kimtex). The nonwoven wipe of the 1990s will be an advanced structure of composite form using pulp, tissue, and fiber, according to Parrella. Specific end uses for nonwoven wipes are proliferating, and these products are now used as wash cloths, clean room wipers, hot towels for airline passengers, napkins, and tablecloths. Nonwoven wipes rank third, after diaper coverstock and health-care applications, as end uses for nonwovens.

PAPERBOARD GRADES

INTRODUCTION

Paperboard is a general term describing heavyweight grades of paper used for containers, boxes, cartons, and packaging materials. Paperboard is divided into three major classes: containerboard, boxboard, and other paperboard.

Containerboard is the largest single grade of paperboard produced and includes three major grade categories: linerboard, corrugating medium, and chip and filler boards. Most of these grades are made from virgin kraft fiber on a fourdrinier paper machine. The bulk of containerboard produced in the U.S. is consumed by domestic corrugated container plants, but a substantial proportion of linerboard—approximately 2.28 million tons in 1987—is exported.

Boxboard grades include (1) folding boxboard, (2) setup boxboard, and (3) foodboard. Folding boxboard is paperboard that is die-cut to be folded into a carton. These cartons are used to package dry cereals, soap powders, pet foods, and other commonly used consumer products. Folding boxboard is made from layers (plies) of recycled fiber on a multi-ply machine, or it is made from bleached kraft pulp on a fourdrinier paper machine. Normally, it is coated to improve printability for better consumer appeal.

Setup boxes are rigid or open boxes ready to receive a product. Major uses are for shoes, jewelry, and candy.

Foodboard is normally produced from bleached kraft pulp on a fourdrinier paper machine. There are a number of grades, each specifically coated, waxed, or otherwise treated to handle moist or oily food products. Typical grades are milk cartons, frozen food packages, ice cream cartons, cupstock, and plates.

Other paperboard includes kraft or recycled paperboard made on either cylinder or fourdrinier paper machines. These paperboards are used for fiber cans, core or drum stock, and liners for gypsum board. Chipboard ("cardboard") is used for pad backings or for packing flat cloths or other articles.

U.S. paperboard production in 1987 totaled 37.5 million short tons—slightly higher on a tonnage basis than paper production at 37.0 million tons but lower in value, according to American Paper Institute data. On a value-of-shipments basis, according to the latest available Bureau of the Census data, paper shipments in 1986 were approximately $25.3 billion, while paperboard shipments were approximately $11.6 billion. Values for both moved up substantially in 1987, according to market reports.

Containerboard is the most important paperboard grade segment, with 1987 production for domestic use totaling 23.0 million tons. Boxboard output for the domestic market is 6.17 million tons, and all other types of paperboard total 5.2 million tons. Paperboard exports, with linerboard and solid bleached board by far the most important categories, totaled over 3.5 million tons in 1987. About 77% of U.S. paperboard is made from mainly solid woodpulp furnish, while 23% is recycled board made from wastepaper.

The Canadian paperboard industry is much smaller, with a total output in 1987 of roughly 2.7 million short tons, according to preliminary Canadian Pulp & Paper Assn. statistics. Linerboard is the most important grade, with 1987 output at 1.255 million tons. Corrugating medium production totaled 698,000 tons, and total boxboard production amounted to 742,000 tons.

Canadian paperboard capacity has been fairly flat over the past decade and the outlook for production is not bright because of the scheduled gradual lowering of tariffs. In addition, the possible elimination of all trade barriers under the proposed U.S./Canada Free Trade Agreement will make imports from the U.S. more competitive.

U.S. MARKET INDICATORS FOR PAPERBOARD CONSUMPTION

	Paperboard consumption (million tons)	Gross National Product	Personal consumption expenditures Durable (billions of 1982 constant $)	Personal consumption expenditures Nondurable (billions of 1982 constant $)	U.S. total industrial production index (1977 = 100)	Paperboard manufacturing capacity utilization
1987	35,810e	3,820	388.2	878.1	129.8	97%
1986	32,873p	3,713	383.5	877.2	125.1	94
1985	30,707	3,607	352.7	849.5	124.2	90
1984	31,551	3,501	323.1	825.9	121.4	94
1983	29,333	3,279	283.1	880.2	109.2	91
1982	26,526	3,166	252.7	771.0	103.1	82
1981	28,741	3,249	250.8	764.9	111.0	91
1980	27,716	3,187	245.9	762.6	108.8	92
1979	29,250	3,192	266.5	766.6	110.7	94
1978	28,335	3,115	267.4	753.7	106.6	93
1977	27,150	2,959	253.9	731.4	100.0	90
1976	26,744	2,827	232.3	708.8	92.6	89
1975	23,311	2,695	205.6	676.5	84.6	79
1970	23,495	2,417	162.5	632.5	78.5	92
1965	20,301	2,088	134.6	543.2	66.1	93
1960	15,475	1,665	98.0	463.3	n.a.	82

e = *Pulp & Paper* estimate.
p = Preliminary.
n. a. = Not available.

Sources: U.S. Dept. of Commerce, American Paper Institute data.

U.S. PRODUCTION OF BOXBOARD AND OTHER PAPERBOARD FOR DOMESTIC USE

(short tons)

	Boxboard—domestic use				
	Total	Folding	Setup	Milk carton & food service	Other*
1986	6,792,300	5,165,400	233,400	1,393,500	7,199,900
1985	6,495,000	4,879,800	234,100	1,381,100	6,497,200
1984	6,535,600	4,876,000	263,800	1,395,800	6,648,500
1983	6,261,100	4,646,000	256,300	1,358,800	6,742,700
1982	5,841,000	4,333,700	223,600	1,283,700	5,716,900
1981	6,216,100	4,587,600	236,000	1,392,500	5,976,100
1980	6,153,100	4,489,900	241,500	1,421,700	6,729,000
1979	6,469,200	4,720,500	306,000	1,442,700	6,135,000
1978	6,501,200	4,702,400	332,700	1,466,100	5,865,500
1977	6,332,300	4,546,700	302,500	1,483,100	5,453,500
1976	6,564,700	4,714,600	331,500	1,518,600	5,174,500
1975	5,663,800	3,896,400	304,500	1,462,900	4,505,700
1970	6,238,700	4,079,700	466,500	1,692,500	5,180,000
1965	5,811,800	3,879,600	547,300	1,384,900	4,321,200
1960	4,894,900	3,291,200	525,100	1,078,600	2,845,000

* Including exports.

Source: American Paper Institute.

U.S. SHIPMENTS[1] OF PAPERBOARD GRADES, 1975-86

(000 short tons)

	1986	1985	1984	1983	1982	1981
TOTAL PAPERBOARD	36,002	33,291	33,515	31,871	28,912	30,566
SOLID WOODPULP FURNISH PAPERBOARD	27,897	25,293	25,619	24,169	22,145	23,950
Unbl. kraft packaging, incl. converting	17,997	16,016	16,718	15,750	14,390	15,707
Unbleached linerboard	16,740	14,897	16,648	14,689	13,297	14,431
Tube, can, and drum paperboard	54	64	74	99	151	334
Other, incl. corrugating medium	1,202	1,055	996	962	941	942
Bl. packaging, incl. converting (80% bl. fiber)	4,535	4,282	4,104	3,988	3,757	4,070
Linerboard	121	(D)	118	113	101	120
Folding carton-type board	2,706	955	1,895	1,901	1,743	1,921
Milk carton board	1,226	1,227	1,092	1,060	1,052	1,085
Heavyweight cup stock	442	422	455	440	418	427
Plate, dish, and tray stock	276	245	225	252	227	245
Bleached paperboard for misc. packaging	45	29	31	31	32	49
Other solid bleached board	348	404	288	191	184	222
Semichemical, incl. corrugating medium, other	5,365	4,995	4,798	4,431	3,998	4,173
RECYCLED PAPERBOARD	8,004	7,901	7,797	7,604	6,607	6,616
Recycled shipping containerboard	2,495	2,561	2,407	2,565	2,097	1,750
Linerboard	761	918	846	879	505	250
Corrugating medium	1,568	1,486	1,397	1,519	1,427	1,315
Container chip and filler board	167	157	164	167	165	185
Recycled folding carton board	2,284	2,268	2,310	2,370	2,153	2,425
Unlined chipboard	441	468	471	585	546	(D)
Kraft-lined	219	203	169	180	146	176
White-lined	168	193	225	227	152	189
Clay-coated	1,456	1,401	1,447	1,378	1,308	(D)
Recycled setup paperboard	273	259	307	263	238	298
Recycled packaging, incl. converting board	2,950	2,814	2,772	2,406	2,119	2,144
Tube, can, and drum stock	1,042	1,021	1,064	858	767	808
Gypsum linerboard	1,145	1,029	915	798	598	634
Panelboard and wallboard stock	64	68	150	148	119	100
Other	698	646	643	602	635	601
WET MACHINE BOARD	101	98	99	98	172	—[2]
CONSTRUCTION PAPER AND BOARD	2,967	3,228	3,010	3,215	2,781	1,460[3]
Construction paper	302	398	394	463	447	616
Sheathing (red rosin, asphalt, house sheathing)	(D)	(D)	(D)	(D)	(D)	(D)
Felts, saturating and dry						
Roofing felts	210	302	(D)	(D)	(D)	510
Other felts, incl. floor covering	(D)	(D)	(D)	(D)	(D)	(D)
Asbestos and asbestos-filled (e.g., electrolytic)	(D)	(D)	(D)	(D)	(D)	(D)
Other building (saturating screenings, etc.)	—	—	(D)	(D)	(D)	(D)
Structural insulation board	—	—	—	—	—	—
Insulating board	732	735	785	713	593	845
Hardpressed board	1,933	2,095	1,831	2,040	1,741	(S)

continued

U.S. SHIPMENTS[1] OF PAPERBOARD GRADES, 1975-86 (continued)

(000 short tons)

	1980	1979	1978	1977	1976	1975
TOTAL PAPERBOARD	31,143	31,168	30,033	29,006	27,960	24,452
SOLID WOODPULP FURNISH PAPERBOARD	23,901	23,585	22,500	21,580	21,008	18,630
Unbl. kraft packaging, ind. converting	15,285	14,903	14,113	13,498	13,146	11,586
Unbleached linerboard	14,249	13,857	13,215	12,660	12,267	10,885
Tube, can, and drum paperboard	220	232	202	180	194	145
Other, incl. corrugating medium	(D)	(D)	(D)	(D)	(D)	(D)
Bl. packaging, ind. converting (80% bl. fiber)	4,034	4,065	4,002	3,883	3,846	3,421
Linerboard	(D)	(D)	(D)	93	103	89
Folding carton-type board	2,063	2,045	1,934	1,822	1,888	1,539
Milk carton board	1,023	1,066	1,048	1,040	1,061	1,052
Heavyweight cup stock	386	375	400	419	363	329
Plate, dish, and tray stock	273	260	227	296	267	275
Bleached paperboard for misc. packaging	33	46	67	55	70	48
Other solid bleached board	78	94	117	106	77	75
Semichemical, incl. corrugating medium, other	4,583	4,617	4,384	4,199	4,016	3,623
RECYCLED PAPERBOARD	7,242	7,583	7,533	7,426	6,952	5,823
Recycled shipping containerboard	2,070	2,050	1,981	1,908	1,468	1,129
Linerboard	518	460	331	379	232	196
Corrugating medium	1,281	1,301	1,408	1,286	1,057	788
Container chip and filler board	271	290	242	243	179	145
Recycled folding carton board	2,350	2,386	2,403	2,423	2,475	2,108
Unlined chipboard	606	678	692	687	698	564
Kraft-lined	81	98	130	133	145	125
White-lined	220	229	251	274	325	274
Clay-coated	1,443	1,380	1,330	1,329	1,307	1,146
Recycled setup paperboard	560	604	697	717	748	672
Recycled packaging, ind. converting board	2,262	2,543	2,453	2,378	2,261	1,913
Tube, can, and drum stock	564	628	602	680	747	631
Gypsum linerboard	1,036	1,210	1,185	1,099	976	821
Panelboard and wallboard stock	113	137	119	114	86	67
Other	548	568	546	485	452	395
WET MACHINE BOARD	138	144	136	129	130	115
CONSTRUCTION PAPER AND BOARD	4,390	5,436	5,625	5,492	5,419	4,648
Construction paper	1,369	1,868	1,915	1,852	1,832	1,616
Sheathing (red rosin, asphalt, house sheathing)	3	14	13	21	22	16
Felts, saturating and dry						
Roofing felts	1,205	1,633	1,672	1,601	1,553	1,402
Other felts, incl. floor covering	(D)	(D)	(D)	(D)	(D)	(D)
Asbestos and asbestos-filled (e.g., electrolytic)	62	100	113	106	114	91
Other building (saturating screenings, etc.)	(D)	(D)	(D)	(D)	(D)	(D)
Structural insulation board	3,021	3,569	3,710	3,640	3,586	3,032
Insulating board	1,051	1,263	1,416	1,403	1,441	1,249
Hardpressed board	1,970	2,306	2,294	2,237	2,145	1,784

Note: Categories shown are those now used by Bureau of the Census. Categories in older reports do not always correspond to the present ones.

(D) Data withheld to avoid disclosing figures for individual companies.

(S) Suppressed because the data did not meet publication standards by Bureau of the Census.

1. Reported as production by Bureau of the Census prior to 1981.

2. Wet machine board included with recycled paperboard to avoid disclosing figure for individual companies.

3. Excludes hardboard.

Source: Bureau of the Census.

U.S. PRODUCTION OF CONTAINERBOARD FOR DOMESTIC USE

(000 short tons)

		Linerboard			Corrugating materials			Chip & filler boards
	Total	Kraft	Recycled	Total	Semichem. & kraft	Recycled	Total	
1987	20,042.0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1986	21,426.5	14,288.6	420.3	14,708.9	5,160.8	1,525.8	6,686.6	31.0
1985	20,042.2	13,467.1	285.8	13,752.9	4,896.6	1,358.8	6,255.4	33.9*
1984	20,855.1	14,068.8	203.7	14,272.5	5,018.9	1,385.4	6,404.3	178.4
1983	19,173.0	12,835.6	289.1	13,124.7	4,532.7	1,305.4	5,838.1	210.2
1982	17,507.5	11,656.5	279.0	11,935.5	4,202.5	1,139.3	5,341.8	230.2
1981	19,040.4	12,754.3	324.2	13,078.5	4,561.2	1,140.9	5,702.1	259.5
1980	18,070.2	11,948.6	444.5	12,393.1	4,398.5	1,047.1	5,445.6	231.5
1979	18,824.8	12,417.3	402.3	12,819.6	4,573.6	1,202.3	5,775.9	229.3
1978	17,908.2	11,877.2	256.4	12,133.7	4,305.3	1,197.7	5,503.1	271.5
1977	17,167.3	11,354.4	341.3	11,695.7	4,128.2	1,079.7	5,207.9	263.7
1976	16,700.2	11,093.2	282.7	11,375.9	3,986.5	1,075.1	5,061.5	262.9
1975	14,586.2	9,646.9	207.3	9,854.2	3,579.4	870.0	4,449.3	282.6
1970	13,964.3	9,133.4	269.7	9,403.1	3,404.7	859.3	4,264.0	297.2
1965	11,199.1	6,698.1	782.5	7,480.6	2,638.2	800.0	3,438.2	280.3
1960	8,186.6	4,731.2	743.6	5,474.8	1,788.9	672.1	2,461.0	250.8

* Reclassification. Balance of chipboard (non-container grades) not included.
n.a. = Not available.

Sources: American Paper Institute, Fibre Box Assn.

U.S. PRODUCTION AND CAPACITY OF PAPERBOARD

(000 short tons)

	Production[1]		Capacity[1]		Utilization rate (%)
	(000 tons)	% change	(000 tons)	% change	
1990e	—	—	41,417	2.5%	—
1989e	—	—	40,410	2.2	—
1988e	—	—	39,521	2.2	—
1987	—	—	38,685	2.4	—
1986	35,503	7.5%	37,763	2.8	94.6%
1985	33,034	–2.9	36,720	2.0	90.0
1984	34,039	6.5	35,992	1.1	95.6
1983	31,951	9.9	35,603	0.5	89.7
1982	29,065	–6.9	35,421	2.8	82.1
1981	31,232	0.9	34,466	1.6	91.2
1980	30,952	–1.9	33,709	0.8	91.8
1979	31,429	3.8	33,436	2.5	94.0
1978	30,275	4.6	32,631	1.4	92.8
1977	28,953	1.8	32,173	0.2	90.0
1976	28,439	14.8	32,097	2.8	86.0
1975	24,756	—	31,218	—	79.3
Average 1970-86		2.0		1.8	

e = Estimate.
1. Excludes capacity for hardpressed boards, wet machine boards, and construction papers and boards.

Source: American Paper Institute (1987 capacity survey).

CANADIAN PAPERBOARD PRODUCTION

(000 short tons)

	Containerboard		Boxboard				Total paper-board
	Liner-board	Corrugating medium	Folding	Non-folding	Bleached board	Other[1]	
1987	1,383	769	n.a.	n.a.	n.a.	n.a.	2,971
1986	1,322	714	391e	114e	—[2]	353e	2,836
1985	1,187	549	385	111	—[2]	332	2.564
1984	1,128	626	363	142	—[2]	329	2,588
1983	1,026	589	355	128	—[2]	295	2,391
1982	967	466	305	115	—[2]	270	2,123
1981	1,182	571	331	130	—[2]	328	2,541
1980	1,224	527	310	118	—[2]	322	2,499
1979	1,145	483	315	119	—[2]	373	2,434
1978	1,146	459	272	133	—[2]	354	2,364
1977	1,011	376	238	133	—[2]	209	2,066
1976	1,025	373	224	80	—[2]	272	1,974
1975	784	343	192	101	—[2]	238	1,658
1970	776	373	250	111	107	233	1,850
1965	595	251	265	104	89	250	1,553
1960	375	208	233	65	14	172	1,067
1955	259	158	186	48	—	219	869
1950	214	152	158	48	4	204	708

n.a. = Not available.
e = Estimate.
1. Includes solid bleached board, mill wrappers, gypsum or plaster board, wet machine board, etc., from 1975 on.
2. Included in "Boxboard, Other."

Source: Canadian Pulp & Paper Assn.

CANADIAN PAPERBOARD CAPACITY

(000 short tons)

	Linerboard		Corrugating medium		Solid bleached board	Boxboard folding, others[1]
	Kraft	Recycled	Semichem.	Recycled		
1989e	1,036	344	664	159	68	806
1988e	1,036	337	611	163	67	790
1987	1,036	335	604	168	67	778
1986	1,022	325	586	161	80	774
1985	1,001	321	565	172	92	787
1984	983	314	576	164	95	785
1983	952	315	581	129	98	747
1982	969	300	564	150	104	732
1981	1,069	322	557	129	102	770
1980	1,056	289	545	114	105	785
1979	1,074	267	520	115	137	832
1978	1,069	272	517	116	135	812
1977	1,300	278	510	116	131	757

e = Estimate
1. Includes mill wrappers but excludes solid bleached board.

Source: Canadian Pulp & Paper Assn., May 1986.

CANADIAN EXPORTS OF PAPERBOARD[1]

(000 short tons)

	Linerboard	Corrugating medium	Boxboard
1986	346	252	71
1985	321	151	69
1984	271	218	95
1983	310	197	63
1982	213	158	31
1981	295	170	37
1980	361	201	40
1979	288	157	39
1978	283	177	54
1977	393	105	20
1976	318	90	7
1975	198	53	11
1974	414	96	22
1973	311	140	23
1972	222	147	17
1971	173	133	22
1970	201	102	13
1965	123	46	16

[1] Canadian imports of paperboard are minor. For example, in 1986, Canada imported 43,000 tons of containerboard.

Source: Canadian Pulp & Paper Assn.

LINERBOARD

Linerboard is a commodity grade of paperboard used in the production of corrugated containers. It is used as the top and bottom facing (liner) placed over corrugating medium (the fluted inner sheet) to form the rigid structure of the combined board. Linerboard provides the strength component of a container, while corrugating medium gives rigidity or stiffness.

Unbleached linerboard is made in a wide range of basis weights. The standard kraft liner is 42 lb/1,000 ft^2, but other important grades are produced in weights of 26, 33, 38, 69, and 90 lb. About 92% of linerboard is unbleached.

Kraft linerboard is produced at large integrated kraft pulp and paper mills. About 83% of U.S. linerboard capacity is located in the South and most of the remainder in the West. Some linerboard is also produced in eastern Canada and British Columbia (see Corrugating Medium chapter for discussion of the Canadian industry).

Most linerboard is produced on wide (220-in.- to 348-in.-trim) conventional fourdrinier paper machines at speeds approaching 2,000 fpm or more. About 60% of industry capacity is now represented by machines with capacity to produce 300,000 to 500,000 tpy. Most machines in the industry have been installed or substantially rebuilt in the last two decades. Linerboard is sold in rolls, the size of the roll determined by corrugator width. Normally, linerboard is produced in two plies—top and bottom liners. The bottom liner, comprising up to 85% of the fiber furnish, is made from high-yield kraft, whereas the top liner, applied with a secondary headbox, is made from a higher-quality pulp (either of lower yield or highly refined) with better sheet properties to permit an adequate level of printing quality at container plants.

Starch is applied to the liner at a size press in order to improve printability. Linerboard may be treated internally with sizes and wet-strength agents to develop desired sheet properties. About 4% of linerboard produced in the U.S. is wet-strength treated. Each weight of linerboard is controlled, normally by refining, to give a minimum burst strength.

NEW QUALITY REQUIREMENTS

Linerboard quality requirements have changed due to industry movement toward more performance-based packaging, improved graphic display quality, and reduced fiber cost.

Compression strength. Basis weight and bursting strength historically have been the two main specifications

U.S. STATISTICS FOR UNBLEACHED KRAFT LINERBOARD

	1989e	1988e	1987
Production, 000 tons	18,320	17,980	17,608
Capacity[1], 000 tons	18,633	18,071	17,704
(adjusted capacity)[2]	(19,283)	(18,521)	(17,954)
Utilization rates[1], %	98.3	99.5	99.5
adjusted rates[2]	(95.0)	(97.1)	(98.1)
Exports[3], 000 tons	2,480	2,365	2,297
Imports[3], 000 tons	90	85	80
Apparent U.S. consumption			
000 tons	15,930	15,700	15,391
lb/capita	128.7	128.0	126.2
000 tons/$ billion real GNP	3.97	3.99	4.03

e = Estimate.

1. Based on American Paper Institute November 1987 capacity survey.

2. Adjusted to reflect shift of capacity from kraft paper production to linerboard, faster than expected incremental expansion, and operating improvements. These factors are estimated to add 250,000 tons to the 1987 capacity base and then an additional 200,000 tons in 1988 and 200,000 tons in 1989.

3. Dept. of Commerce data.

that linerboard mills must meet under carrier freight classifications (railroad Rule 41 and trucking Item 222) regulating corrugated shipping containers. Many mills now offer linerboard and medium which meet certain minimum ring-crush levels. Ring crush (or STFI short-compression test) relates to the top-to-bottom compression strength of the finished corrugated box.

Bursting strength is a measure of how well a corrugated container will protect its contents during individual loading into railroad cars. Increased transport and stacking of boxes on pallets has made compression strength an important measure of box performance (see also Converted Products section). The movement to more performance-based packaging will lower linerboard basis weights, permit use of less linerboard and more corrugating medium, and permit use of lower-cost fiber and reduce fiber use overall.

Secondary fiber use. Kraft linerboard is made predominantly from softwoods (southern pine, Douglas fir, and eastern pines and spruces), but it may also contain some hardwood kraft pulp. Use of wastepaper fiber in kraft linerboard has also grown, increasing from 4% of total fiber furnish in the late 1970s to around 11% currently. The principal wastepaper grades used are recycled corrugated containers (old corrugated) and new double-lined kraft cuttings. Usage varies, but the maximum amount of wastepaper consumed by any kraft linerboard mill is generally not over 25% of total fiber furnish.

A few U.S. mills produce linerboard from 100% wastepaper, called "test" linerboard, either on fourdrinier or multi-ply cylinder machines. Testliner is made in the 85- to 100-lb burst range. Production of recycled linerboard in the U.S. rose to 474,000 tons in 1987. The increase reflected the startup of Inland Container Corp.'s new 175,000-tpy recycled linerboard mill in Ontario, Calif., in 1985. Several other companies are studying reactivation of idle machines to make recycled linerboard. Production of recycled liner is expected to grow in the U.S. because of the lower capital cost of building recycled mills and because of political pressure to recycle more wastepaper.

Graphic display. Most U.S. linerboard is unbleached, but grades offering a white printing surface are growing in importance and currently account for about 8% of total production. This reflects growing use of corrugated containers for point-of-purchase display in retail outlets. The most common grade for this application is "mottled white" linerboard, in which a thin layer of bleached fiber is added to the top of an unbleached sheet. Production of mottled white board in 1987 totaled more than 1.0 million tons, and it has grown at a 7.7%/year rate since 1980.

A higher-quality, more expensive alternative is uncoated solid bleached linerboard. Production of solid bleached linerboard in 1987 totaled 137,000 tons, growing at a 4.4%/year rate. A third alternative offering even higher graphic quality is the use of coated kraft board in the

U.S. PRODUCTION AND CAPACITY OF UNBLEACHED LINERBOARD

(000 short tons)

	Production		Capacity		Operating
	Tonnage	% change	Tonnage	% change	rate
1990e	—	—	19,195	3.0%	—
1989e	—	—	18,633	3.1	—
1988e	—	—	18,071	2.1	—
1987	17,608	7.4%	17,704	3.1	99.5%
1986	16,402	8.0	17,175	2.6	95.4
1985	15,183	–5.3	16,739	1.1	90.7
1984	16,037	6.9	16,565	1.8	96.8
1983	15,007	11.2	16,217	1.5	92.5
1982	13,494	–7.2	16,032	4.3	84.2
1981	14,540	2.2	15,372	5.2	94.6
1980	14,232	2.0	14,586	2.7	97.6
1979	13,951	5.5	14,199	2.4	98.3
1978	13,228	5.2	13,864	1.9	95.4
1977	12,573	2.6	13,586	1.4	92.5
1976	12,251	12.4	13,448	2.4	91.1
1975	10,635	–10.6	13,138	1.8	80.9
1974	12,333	–3.7	12,901	0.3	95.6
1973	12,536	4.4	12,862	2.3	97.5
1972	12,335	9.1	12,568	6.5	98.1
1971	11,308	3.0	11,797	0.6	95.9
1970	10,982	0.3	11,718	—	93.7

e = Estimate.
Source: American Paper Institute.

preprint process (see Coated and Uncoated Kraft Board chapter and Converted Paper and Board Products chapter). Use of such coated board is believed small because preprint has been slow to develop high-volume applications. Chesapeake Corp. in late 1988 plans to introduce a white-top linerboard grade into the U.S. which the company hopes will open the volume end of the high-quality graphics market for preprint, according to Frederick V. Ernst, group vice president.

MONTHLY CONTAINERBOARD INVENTORY AT U.S. BOX PLANTS AND MILLS

(000 short tons/weeks of supply*)

	1988**		1987		1986		1985		1984	
Month	**Tons**	**Weeks**	**Tons**	**Weeks**	**Tons**	**Weeks**	**Tons**	**Weeks**	**Tons**	**Weeks**
Jan. 1	2,486	5.9	2,238	6.0	2,549	7.1	2,882	8.4	2,437	7.2
Feb. 1	2,663	5.9	2,340	5.6	2,502	5.7	2,970	7.4	2,408	6.0
Mar. 1	2,589	5.8	2,391	5.4	2,489	6.1	2,955	7.7	2,467	6.4
Apr. 1	2,513	5.6	2,414	5.6	2,518	6.2	3,023	8.0	2,448	6.4
May 1	2,552	5.4	2,375	5.2	2,438	5.5	2,987	7.3	2,512	6.2
June 1	—	—	2,383	5.6	2,394	6.1	2,945	7.6	2,541	6.5
July 1	—	—	2,385	5.4	2,320	5.5	2,838	7.5	2,659	7.1
Aug. 1	—	—	2,497	5.6	2,389	5.7	2,821	7.3	2,767	7.2
Sep. 1	—	—	2,437	5.5	2,344	5.8	2,694	7.0	2,711	7.0
Oct. 1	—	—	2,421	5.2	2,269	5.2	2,560	6.1	2,702	6.9
Nov. 1	—	—	2,352	5.0	2,181	4.8	2,492	5.8	2,602	6.2
Dec. 1	—	—	2,396	5.7	2,134	5.3	2,469	6.6	2,650	7.1

	1983		1982		1981		1980		1979	
Month	**Tons**	**Weeks**	**Tons**	**Weeks**	**Tons**	**Weeks**	**Tons**	**Weeks**	**Tons**	**Weeks**
Jan. 1	2,584	8.9	2,729	9.4	1,984	6.2	1,979	6.2	1,961	5.8
Feb. 1	2,485	7.1	2,482	7.5	1,960	5.5	1,991	5.3	1,825	5.1
Mar. 1	2,462	7.2	2,468	7.3	2,029	5.6	1,905	5.4	1,807	5.1
Apr. 1	2,414	6.8	2,570	7.4	2,104	5.7	1,890	5.4	1,789	5.0
May 1	2,495	6.9	2,656	7.6	2,232	5.9	2,021	5.7	1,846	4.8
June 1	2,463	6.8	2,671	8.1	2,298	6.7	2,119	6.5	1,856	5.2
July 1	2,511	6.8	2,650	7.9	2,368	6.7	2,248	7.0	1,863	5.3
Aug. 1	2,486	7.4	2,595	8.3	2,371	6.9	2,291	7.3	1,939	5.5
Sep. 1	2,421	6.6	2,553	7.5	2,376	6.9	2,225	7.1	1,945	5.6
Oct. 1	2,339	6.0	2,393	6.5	2,451	6.6	2,101	5.8	1,938	5.3
Nov. 1	2,302	5.8	2,424	6.9	2,437	7.1	1,880	5.6	1,877	4.8
Dec. 1	2,415	6.5	2,524	7.6	2,602	7.9	1,836	5.5	1,953	5.5

	1978		1977		1976		1975		1974	
Month	**Tons**	**Weeks**	**Tons**	**Weeks**	**Tons**	**Weeks**	**Tons**	**Weeks**	**Tons**	**Weeks**
Jan. 1	2,437	7.2	2,507	8.0	2,185	7.2	2,323	8.9	1,595	4.7
Feb. 1	2,297	7.0	2,376	7.8	2,136	7.0	2,156	8.5	1,541	4.6
Mar. 1	2,242	6.6	2,393	7.7	2,138	7.1	2,233	9.0	1,527	4.6
Apr. 1	2,208	6.1	2,412	7.5	2,172	7.0	2,264	9.0	1,558	4.7
May 1	2,179	6.4	2,463	7.4	2,316	7.4	2,306	9.1	1,623	5.0
June 1	2,155	6.0	2,513	7.5	2,393	7.5	2,296	8.6	1,732	5.4
July 1	2,169	6.1	2,577	8.0	2,506	8.2	2,244	8.1	1,810	5.8
Aug. 1	2,206	6.6	2,581	8.3	2,539	8.4	2,125	7.8	1,833	5.9
Sep. 1	2,119	6.0	2,613	8.0	2,604	8.5	2,079	7.0	1,907	6.3
Oct. 1	2,004	5.5	2,457	7.2	2,442	7.7	1,969	6.1	1,925	6.4
Nov. 1	1,923	5.1	2,439	7.1	2,456	7.6	1,964	6.4	1,965	6.7
Dec. 1	1,939	5.6	2,442	7.2	2,516	7.9	2,079	6.9	2,078	7.0

* Obtained by dividing inventories by average weekly usage in corrugated box plants during prior month, excluding holidays.
** Preliminary.

Source: Fibre Box Assn.

Multi-ply forming. The need for linerboard with

RATIO OF U.S. CONSUMPTION OF PAPERBOARD TO CORRUGATED CONTAINER PRODUCTION

CORRUGATING MEDIUM TONNAGE FOR CONTAINERS

	Consumption by box plants (000 short tons)		Ratio (liner/ medium)
	Liner-board	Corrugating medium	
1987	15,276	7,086	2.16
1986	14,414	6,689	2.15
1985	13,605	6,247	2.17
1984	13,461	6,177	2.18
1983	12,594	5,768	2.18
1982	11,751	5,337	2.20
1981	12,262	5,530	2.22
1980	12,019	5,427	2.21
1979	12,456	5,654	2.20
1978	12,168	5,495	2.21
1977	11,318	5,103	2.22
1976	10,782	4,844	2.22
1975	9,609	4,320	2.22
1974	10,621	4,746	2.24
1973	11,315	5,060	2.24
1972	10,429	4,698	2.22
1971	9,465	4,273	2.22
1970	9,079	4,107	2.21

LINERBOARD TONNAGE FOR CONTAINERS

	Corrugator production (billion ft^2)	Linerboard consumed by box plants (000 tons)	Ratio (1,000 ft^2/ ton)
1987	318.5	15,276	20.850
1986	302.0	14,414	20.950
1985	284.8	13,605	20.933
1984	282.0	13,461	20.949
1983	264.2	12,594	20.980
1982	246.3	11,751	20.960
1981	253.0	12,262	20.633
1980	251.9	12,019	20.958
1979	261.1	12,456	20.962
1978	256.4	12,168	21.072
1977	238.8	11,318	21.099
1976	227.8	10,782	21.128
1975	203.2	9,609	21.147
1974	224.1	10,621	21.100
1973	238.5	11,315	21.078
1972	220.1	10,429	21.105
1971	200.3	9,465	21.162
1970	192.7	9,079	21.225
		Average:	20.016

Source: Based on data from Fibre Box Assn.

higher cross-machine strength (measured by ring crush) and improved printing surface led to growing interest in multi-ply linerboard forming. Beyond the traditional fourdrinier and secondary headbox, some U.S. companies are adding top-wire dewatering units or minifourdriniers to produce two- or three-ply sheets. Willamette Inc. is adding Bel Bond formers to all of its linerboard machines and several other companies are planning similar installations. Georgia-Pacific Corp. recently rebuilt its No. 2 machine with an Escher Wyss top-former fourdrinier to produce a two-ply board. Chesapeake Corp. in 1985 started up a new Voith machine at its West Point, Va., mill with four forming sections to produce a three-ply sheet.

These machines can use a variety of different fiber furnishes and also produce partially bleached grades such as white-top or mottled board. Low cross-machine variation in basis weight and moisture profile also is important for high-speed converting.

High-pressure presses. Companies are installing high-impulse or wide-nip presses to add incremental capacity and to improve sheet strength. High-impulse presses make use of higher-than-usual linear press loadings, typically 1,000 to 2,000 pli or greater, combined with double felting, and a nip width of 3.0 to 3.5 in. Wide-nip presses (such as Beloit Corp.'s Extended Nip Press) usually increase nip pressure in the press section by passing a sheet between a single-grooved press roll opposed by a stationary loaded shoe. Pressure equivalent to 4,500 to 6,000 pli can be achieved because of the longer dwelltime of the sheet in the double-felted press (with nips ranging up to 10 in.).

The increased pressure can reduce steam requirements per ton in the dryer section by as much as 15% to 25% and permit an increase in incremental capacity of 8% to 12% or more. Dryness of the sheet leaving the press can be raised to more than 50%, and some mills are installing tandem high-intensity or wide-nip press sections to achieve after-press dryness levels approaching 60%. Wide-nip presses also increase sheet strength or permit mills to use more secondary or hardwood fiber while maintaining the same strength level.

MARKET STRUCTURE

The U.S. linerboard industry in 1987 produced 17.6 million tons of kraft linerboard, of which about 2.3 million tons was exported. (As previously noted, the industry also produced 474,000 tons of recycled linerboard.)

The U.S. linerboard industry has a fairly high degree of integration, with about 73% of production transferred by companies to their own box plants or swapped with other producers to save on freight costs. About 15% of production is sold by producers to independent corrugated converters, and the remaining 13% to 14% is exported overseas. A small amount of linerboard also finds its way into miscellaneous uses such as tube, can, and core stock.

The two main determinants of linerboard demand are domestic corrugated box production and linerboard export shipments. Corrugated box shipments in turn closely track industrial production, and over the past decade they have grown at a 2.8%/year rate. Linerboard production during the 1978-87 period grew at a 3.6%/year rate, reflecting somewhat stronger growth in export shipments. U.S. linerboard exports grew at a 7.3%/year rate over the past decade, helped by strong demand from Far East markets.

Linerboard prices tend to be highly cyclical, usually rising during the middle and later stages of an economic recovery but falling when demand weakens and producers have to fight for business to keep their capital-intensive mills running. Pricing tends to be strongest when operating rates are around 95% or higher and when inventories are below six weeks of supply. Normally, linerboard and corrugating medium prices tend to push up corrugated container prices. Containerboard accounts for about 50% to 55% of the cost of making a corrugated container.

In market downturns, prices sometimes drop down close to variable manufacturing costs (including delivery). The largest cost factor in producing linerboard is wood, which accounts for about 36% of total manufacturing costs (including interest and depreciation). Labor accounts for 13% of total costs, followed by energy (8% to 9%) and chemicals (5%). Domestic delivery costs average about $30 to $35/ton, while delivery costs are about $40 to $50/ton to Europe and about $55 to $70/ton to the Far East.

The U.S. is the world's largest linerboard producer and exporter. Total world linerboard production is estimated at about 38 million tons, of which 26 million tons is kraft linerboard and 12 million tons is recycled linerboard, according to a recent study by Resource Information Systems Inc. of Lexington, Mass. World kraft linerboard exports are estimated at about 5 million tons, of which the largest producers are the U.S., Sweden, Canada, Finland, and Brazil.

CURRENT MARKET CONDITIONS

After a dismal performance during the first half of the 1980s, the U.S. linerboard industry began a strong recovery in 1986-87 and currently enjoys a period of unprecedented profitability. The most important factor behind this recovery is the decline of the U.S. dollar. Since 1985, the decline of the dollar against most major world currencies has stimulated U.S. manufacturing activity (and with it demand for corrugated boxes) and boosted U.S. linerboard exports shipments. Corrugated box shipments have shown unusual strength, growing at a faster rate than U.S. industrial production. The recent recovery in the linerboard industry followed a slump in 1985 due to the earlier rise of the dollar that was as severe as any recession. Corrugated box shipments (ft²) declined 0.4% that year, while linerboard exports dropped to 1.8 million tons from 2.16 million tons in 1984 and from 2.3 million tons in 1983. Domestic demand was not strong enough to absorb the additional supply, and containerboard inventories at box plants and mills began to mount, hitting a record of 3.0 million tons (8.0 weeks of supply) in April 1985.

From the $350/ton level the industy reached in the fall of 1984, the price of linerboard eroded until early summer, finally bottoming out at the $250 to $260/ton level. Average mill net prices were even lower due to $10 and $20/ton zone rebates based on shipping distance and even more abysmal export prices. Such price levels were far below the estimated $280 to $290/ton break-even level for an average southern mill (including depreciation and freight). What helped limit the gush of red ink for many U.S. integrated producers was the fact that corrugated box prices eroded much more slowly than linerboard prices. While linerboard prices declined by about 25% during this period, corrugated box prices eroded only about 12%.

The linerboard market began to recover in 1986, and

CURRENT LINERBOARD GRADE STRUCTURE

Basis weight (lb/1,000 ft²)	Grade distribution (%)
26	5
33	11
38	7
42	50
47	—
69	21
90	4
other	2

Source: Fibre Box Assn., 1984

FACTORS FOR CONVERTING PRICES FROM $/TON TO $/1,000 FT² AND FROM $/1,000 FT² TO $/TON

Basis weight (lb/1,000 ft²)	FACTOR 1 $/1,000 ft² to $/ton	FACTOR 2 $/ton to $/1,000 ft²
26*	76.92	0.01300
31*	64.52	0.01550
33*	60.61	0.01650
36*	55.56	0.01800
38	52.63	0.01900
42	47.62	0.02100
47	42.55	0.02350
69	28.98	0.03451
90	22.22	0.04500

To convert the price per 1,000 ft² to equivalent price on a per-ton basis, multiply the price by FACTOR 1. For example, if the price of 33-lb linerboard is $4.79/1,000 ft², multiply $4.79 by 60.61. The price per ton is $290.

To convert the price per ton to equivalent price per 1,000 ft², multiply price by FACTOR 2.

* Corrugating medium weights. Linerboard is normally produced at 26, 33, 38, 42, 47, 69, and 90 lb/1,000 ft².

producers pushed through a $30/ton increase to $290 in April and another $30/ton increase to $320 in the fall. U.S. linerboard production jumped 8% for all of 1986, helped by a 6.2% rise in corrugated box shipments and a 20% jump in export shipments back to 2.18 million tons. Inventories of containerboard dropped sharply and by the end of the year hit a low of 2.13 million tons in December (with weeks of supply bottoming out at 4.8 weeks in November).

CAPACITY RANKING OF U.S. KRAFT LINERBOARD PRODUCERS

	Annual capacity (000 short tons)	Capacity share (%)
1. Stone Container	2,535[1]	14.0%
2. International Paper	1,670	9.2
3. Weyerhaeuser	1,480	8.2
4. Union Camp	1,250	6.9
5. Georgia-Pacific	1,220	6.8
6. Great Northern Nekoosa (Great Southern/ Nekoosa Packaging)	1,220[2]	6.8
7. Temple-Inland	1,175[3]	6.5
8. Jefferson Smurfit	860[4]	4.8
9. Packaging Corp. of America	745	4.1
10. Willamette Industries	740	4.1
11. Gaylord Container	620[5]	3.4
12. Westvaco	610	3.4
13. Longview Fibre	580	3.2
14. Macon Kraft	550[6]	3.0
15. St. Joe Paper	465	2.6
16. MacMillan Bloedel	420	2.3
17. Boise Cascade	395	2.2
18. Green Bay Packaging (Arkansas Kraft)	365	2.0
19. Chesapeake	350	1.9
20. Interstate Resources	280	1.5
21. Champion International	280	1.5
22. Simpson Paper (Simpson Tacoma Kraft)	215	1.2

Total U.S. capacity (1988): 18.071 million tons
Capacity share of top 5 companies: 45.1%
Capacity share of top 10 companies: 71.1%

1. Includes Stone Container's 49% interest in Seminole Kraft Corp. mill in Jacksonville, Fla., reactivated in 1987 (total liner capacity 350,000 tpy).
2. Includes Great Southern Paper Co. and Nekoosa Packaging Corp. acquired from Owens-Illinois Inc. in 1987.
3. Includes 410,000-tpy Rome, Ga., mill taken over by Temple-Inland after 1987 dissolution of Georgia Kraft Co. joint venture with Mead Corp. Excludes 190,000-tpy recycled liner mill in Ontario, Calif.
4. Includes 50% of Container Corp. of America (563,000-tpy liner capacity), acquired by Smurfit and Morgan Stanley Leveraged Equity Fund in 1986.
5. Includes Louisiana-Pacific Corp.'s former Fibreboard mill in Antioch, Calif. (160,000 tpy), acquired in 1988.
6. Former Georgia Kraft Co. mill in Macon, Ga., acquired by Pratt Holdings Pty. of Australia in 1987.

Source: *Pulp & Paper* estimates.

The market continued to tighten in 1987, with linerboard mill operating rates rising from 95.4% in 1986 to 99.5% for the entire year. Producers pushed through a $30/ton price increase to $350 in January, followed by another increase to a new peak of $380 in August 1987. U.S. export shipments rose 5.4% to 2.29 million tons, and they were probably held back by linerboard availability. Containerboard inventories, rose by nearly 248,000 tons during the year, bringing inventories to a normal level.

Strong market conditions continued into 1988, with linerboard mills continuing to run at full capacity. Producers implemented another $30/ton price increase to $410 in March, but they will probably not try to implement another increase in 1988—especially after Stone Container Corp., the largest U.S. producer, announced that it would increase prices by $40/ton on Jan. 1, 1988. Pre-price increase buying will probably keep linerboard demand strong through the end of the year, even though corrugated shipments may grow at a slower rate after a 4.4% surge in the first half of 1988.

Linerboard producers have enjoyed almost unprecedented profitability; while prices have climbed $150/ton since 1985, manufacturing costs have remained relatively stable. The average southern mill will have an estimated pretax profit of close to $110/ton in 1988 (including depreciation and interest). This followed an essentially break-even performance by the industry during the first half of the 1980s, with losses in 1982-83 and 1985.

Profitability on the integrated level is somewhat lower because corrugated box prices did not rise as rapidly as linerboard prices, particularly in the early stages of the recovery. From a trough of $37.73/1,000 ft² in the first quarter of 1986, box prices finally exceeded their 1984 peak in the second quarter of 1987, and by the fourth quarter of 1987 they reached $44.89. From the late-1985/early-1986 trough through the end of 1987, linerboard prices rose close to 46% while box prices increased about 19% (although they fell less sharply in the last industry downturn).

CAPACITY EXPANSION

The rate of U.S. linerboard capacity expansion is gaining momentum as high operating rates and rising prices improve potential return on investment. American Paper Institute's fall 1987 survey showed linerboard capacity rising at a 3.3%/year rate over the 1988-90 period, up from a 2.3%/year rate during the 1985-87 period. Most of the increase is from incremental expansion activity, particularly the installation of high-pressure presses, and from the shift of kraft paper capacity to linerboard production.

The spread of new high-pressure presses, in particular, may be responsible for a faster-than-normal upward "creep" in the U.S. industry's capacity base. For example, API's 1984 fall survey projected total unbleached kraft paperboard capacity would reach 18.384 million tons by the end of 1987. The 1987 fall API survey estimated the figure at 19.453 million tons, and a spring 1988 API Fourdrinier

Kraft Board Group survey placed the final figure at 19.827 million tons. Historically, industry capacity has risen from about 300,000 to 400,000 tons during the four-year span between when capacity is first estimated and when it becomes the base year of a new forecast. During the 1983-87 span, capacity creep turned into a surge, jumping 1.4 million tons.

Only two new kraft linerboard machines have been announced. Union Camp Corp. announced a 460,000-tpy lightweight linerboard machine as part of a $375-million modernization of its Savannah, Ga. mill. (Net capacity increase would be about 150,000 tpy, however, because of the mothballing of two older machines.) Gaylord Container plans to install a 350,000-tpy linerboard machine at its Bogalusa, La., mill in 1990. In addition, Mead Corp. is installing a new 420,000-tpy coated kraft board machine for 1990 startup at its Mahrt, Ala., mill, which may produce 40% to 50% unbleached linerboard in its early years.)

Linerboard prices are still below the level needed to justify investment in new greenfield mills. In a recent speech, Victor A. Casebolt, senior vice president of International Paper Co., estimated that it would take a price of $450 to $480/metric ton to obtain an after-tax return of 12% on a new 1,000 tpd linerboard mill. He estimated that a recycled mill could be justified at prices in the $420 to $450 range. The cost of a new kraft linerboard mill would be $350,000/daily ton vs $260,000 for a recycled mill. Because of such economics, a number of companies, including IP, have studied construction of new recycled linerboard mills or upgrading of older existing facilities.

Incremental expansion in vogue. A popular incremental expansion strategy has mills installing high-impulse or wide-nip presses accompanied by the addition of a wastepaper recycling line or debottlenecking of kraft recovery system. High-pressure presses can add as much as 8% to 12% incremental capacity to an existing

U.S. LINERBOARD INDUSTRY CONSOLIDATION

Year	Acquiring company	Selling entity	Capacity of assets Unbleached[1] (000 tons)	Total capacity (000 tons)	Price (million $)
1988	Gaylord Container	Louisiana-Pacific (Antioch mill)	247	247	$156
1987	Great Northern Nekoosa	Owens-Illinois (Forest Products Div.)	1,040	1,040	1,170
1987	Pratt Holdings	Georgia Kraft (Macon mill)	525	525	272[2]
1987	Stone Container	Southwest Forest Industries	440	960	766
1986	Mid-America Packaging	Crown Zellerbach (Gaylord Container)	716	716	260
1986	Stone Container	Jacksonville Kraft	490	490	112
1986	Jefferson Smurfit	Mobil (Container Corp. subsidiary	1,270	1,903	1,139[2]
1986	Temple-Inland	Owens-Illinois (Orange mill and box plants)	400	400	228[2]
1986	Stone Container	Champion International (Brown Systems Group)	1,027	1,027	426
1985	Mid-America Packaging	Weyerhaeuser (Pine Bluff mill)	112	112	28
1985	Simpson	Champion International (Tacoma mill)	288	372	27
1984	Boise Cascade	Sonat (remaining 50% interest in Boise Southern)	340	652	195[2]
1984	Georgia-Pacific	St. Regis (Monticello mill and box plants)	578	578	375[2]
1983	Stone Container	Continental Group (Brown Systems Group)	1,315	1,315	509
	Total acquisitions completed—14 transactions		8,788[2]	10,337	5,663[2]

1. Includes linerboard, corrugating medium, and kraft paper.
2. Includes timber assets.

Source: Morgan Stanley & Co.

machine, and they can be installed relatively quickly. About half of the 69 existing unbleached kraft paperboard machines in the U.S. industry are equipped with high-pressure press sections. Eventually, most machines could have such presses, indicating that another 700,000 to 1.0 million tpy of new incremental capacity could come from such rebuilds.

As previously noted, a number of mills are rebuilding their machines with top formers to improve sheet quality, but such projects may also add incremental capacity. About 17 U.S. linerboard mills have incremental capacity expansion projects under way that will add 50,000 tpy or more of capacity during the 1988-91 period.

Kraft paper swing capacity. Another source of linerboard capacity is the shift of swing machines away from kraft paper to linerboard production. The kraft paper market has declined since 1979 because of the penetration of plastic bags in the grocery sack market and because of sluggish shipments of multiwall sacks. Plastic bags in 1987 captured about 36% of the U.S. grocery sack market, and by 1990 they could have 50% of the market, according to Thomas P. Clephane of Morgan Stanley & Co. Total kraft paper production dropped 16% (630,000 tons) between 1979 and 1986, and shipments declined another 6.9% (228,000 tons) in 1987.

A substantial portion of this capacity was shifted to white paper production by such companies as Champion International, International Paper, and Georgia-Pacific. But about 200,000 to 250,000 tpy of additional linerboard capacity in 1987-88 may come from conversion of kraft paper machines, with production of heavier-weight board adding 20% or more to the machine's capacity. About 13 swing kraft paper machines are still in operation, accounting for 12% of kraft board production or 27% of kraft paper output.

Basis weight reduction. Another source of future linerboard capacity may come from the increased use of high-performance linerboard, which would permit use of lower basis weights and would result in increased industry yield. A number of companies such as Great Northern Nekoosa (Nekoosa Packaging), Stone Container, International Paper, Union Camp, and Weyerhaeuser offer similar grades of high ring-crush linerboard and medium.

For example, a minimum 90-lb ring-crush board (with a nominal 45-lb basis weight) might be used to substitute for 55-lb linerboard, and 115-lb minimum ring-crush board (nominal 56-lb basis weight) may be used in place of 69-lb liner to achieve the same compression strength. Ring crush for normal 42-lb linerboard in the U.S. averages around 75 lb, according to a survey conducted by one company.

The use of such containerboard has grown, despite historical Rule 41 requirements, because of the obvious

MAJOR U.S. LINERBOARD EXPANSION PROJECTS

Company	Mill location	Capacity (000 short tpy)	Startup date
Champion International	Roanoke Rapids, N.C.	50	1988
Georgia-Pacific	Monticello, Miss.	177	1988
Jefferson Smurfit	Fernandina Beach, Fla.	80	1988
Union Camp	Montgomery, Ala.	142	1988
Willamette	Campti, La.	50	1988
International Paper	Vicksburg, Miss.	83	1989
Jefferson Smurfit	Jacksonville, Fla.	88	1989
Macon Kraft	Macon, Ga.	70	1989
Temple-Inland	Rome, Ga.	176	1989
	Orange, Tex.	90	1989
Weyerhaeuser	Springfield, Ore.	75	1989
	Valliant, Okla.	72	1989
Chesapeake	West Point, Va.	60	1990
Gaylord Container	Antioch, Calif.	120	1990
	Bogalusa, La.*	350	1990
Green Bay Packaging	Morrilton, Ark.	175	1990
Great Northern Nekoosa	Cedar Springs, Ga.	80	1991
Mead	Mahrt, Ala.*	150-200[1]	1991
Packaging Corp. of America	Counce, Tenn.	72	1991
Union Camp	Savannah, Ga.*	200 (net)[2]	1991

* New machine.

[1] New Mead machine is designed to produce 420,000 tpy of clay-coated kraft board (mainly for folding carton use), but initial production may be 40% to 50% linerboard.

[2] Net capacity increase after installation of new 460,000-tpy linerboard machine and shutdown of two older machines (one of which makes kraft paper).

cost savings. Also, many boxes do not have to comply with freight regulations, either because they are shipped by private or contract carriers or because of their design or use (including half-slotted trays, produce boxes that carry their own certificates, meat and poultry boxes, and displays).

INDUSTRY RESTRUCTURING

The U.S. linerboard industry went through a major period of consolidation during the past five years because of its earlier poor financial results. Some large diversified companies (Continental Group, Owens-Illinois Inc., and Mobil Corp.) with minor nonstrategic interests in the linerboard industry decided to sell their operations. Other companies became available (St. Regis and Crown Zellerbach) because of attacks by corporate raiders. At the same time, some companies (Stone Container Corp., Jefferson Smurfit Corp., and Gaylord Container Corp.) used leveraged financing techniques to take advantange of the low asset values and to significantly expand their position in the linerboard industry.

According to Thomas P. Clephane of Morgan Stanley & Co., about 8.8 million tons of containerboard/kraft paper capacity changed ownership (31% of total industry capacity) in 14 transactions during the 1983-88 period. The largest of these included Stone Container Corp.'s multiple acquisitions of Continental Group's linerboard/kraft paper operations for $509 million, most of Champion's unbleached mills for $426 million, Jacksonville Kraft for $112 million, and Southwest Forest Industries for $766 million. Meanwhile, Jefferson Smurfit and a Morgan Stanley investment group acquired Container Corp. of America from Mobil for $1.14 billion. And Gaylord Container acquired a kraft paper mill from Weyerhaeuser in 1985, the former Crown Zellerbach containers board division in 1986, and Lousiana-Pacific's Antioch, Calif., mill in 1988.

Some major established paper companies also expanded their positions in the industry. Great Northern Nekoosa significantly increased its level of integration into box converting through the purchase of Owens-Illinois' Forest Products division for $1.17 billion in 1987. Major mill purchases were also made by Georgia-Pacific (St. Regis' Monticello, Miss., mill), Boise Cascade (remaining 50% of the De Ridder, La., mill from Sonat) and Temple-Inland (O-I's Orange, Texas, mill).

The only major foreign company investment was Pratt Pty. Holdings' purchase of the former Georgia Kraft Co. mill in Macon, Ga., for an estimated $272 million. The Australian company also acquired about a half-dozen box plants. The sale of Macon was part of the dissolution of the Georgia Kraft joint venture in which one parent, Temple-Inland, took the company's Rome, Ga., mill and the other, Mead Corp., took the Mahrt, Ala., mill to focus on producing coated kraft board.

Many of these acquisitions were made at extremely attractive prices. For example, the cost per daily ton of capacity for Stone Container Corp.'s acquisitions was $137,000/daily ton for the Continental Group and $147,000/daily ton for Champion's unbleached mills, while Smurfit/Morgan Stanley paid $212,000/daily ton for Container Corp. of America. (These figures include timber, box plants, and other paper/board grades in the total purchase price). However, improving industry profitability caused asset values to rise. Great Northern Nekoosa, for example, paid close to $400,000/daily ton for its later acquisition of O-I's Forest Products Div., but this also reflected the quality of the assets involved.

As a result of improved market conditions and aggressive cost cutting, the acquisition strategy of companies such as Stone Container and Jefferson Smurfit paid off dramatically. Smurfit, for example, estimated that it reduced CCA's expenses by $190 million in 1987, and it may achieve another $50 million in cost reductions and productivity improvements in 1988. CCA's profit in 1988 is expected to reach about $100 million, up from only $30 to $40 million in 1984-85. From a break-even profit in 1985, Stone Container may earn close to $300 million in 1988. These two companies have rapidly paid down debt incurred in these highly leveraged acquisitions.

HISTORY OF EASTERN U.S. CONTAINERBOARD PRICES, 1972-40

($/short ton)

Effective date of price changes	Linerboard (42-lb)	Semichemical medium (26-lb)
Sep. 1, 1972	$130.00	$123.00
Oct. 1, 1963	127.50	120.00
Apr. 1, 1962	122.50	115.00
June 15, 1961	114.75	—
Mar. 15, 1961	—	106.00
Nov. 15, 1961	—	110.00
Nov. 1, 1960	—	119.25
Apr. 1, 1956	127.50	132.50
Sep. 1, 1953	122.50	127.50
Jan. 1, 1951	117.50	122.50
Nov. 1, 1950	112.50	117.50
Aug. 1, 1950	105.00	110.00
May 17, 1949	100.00	105.50
Feb. 1, 1948	105.00	—
Mar. 1, 1947	—	110.75
Feb. 1, 1947	100.00	100.00
Sep. 1, 1946	—	82.50
Apr. 1, 1946	74.00	—
Oct. 1, 1945	66.00	—
Jan. 1, 1944	—	77.00
Apr. 1, 1943	63.00	74.00
Jan. 1, 1943	—	68.50
Nov. 1, 1941	—	60.00
July 1, 1941	60.00	57.50
May 1, 1941	55.00	—
Apr. 1, 1941	—	53.00
Jan. 1, 1940	52.50	50.00

Source: *Pulp & Paper Pricebook.*

U.S. PRICES FOR UNBLEACHED KRAFT LINERBOARD

(42-lb, eastern U.S.)

	$/short ton**	$/1,000 ft^2
1987		
4Q	$380	$7.98
3Q	350/380	7.35/7.98
2Q	350	7.35
1Q	350	7.35
1986		
4Q	320	6.72
3Q	310/320	6.51/6.72
2Q	280/290	5.88/6.09
1Q	260*	5.46
Year-end		
1985	250/260*	5.23/5.46
1984	320/350	6.72/7.35
1983	290	6.09
1982	250*	5.25
1981	270*	5.67
1980	270	5.67
1979	250	5.25
1978	220	4.62
1977	185*	3.89
1976	205*	4.31
1975	195	4.10
1974	195	4.10
1973	145	3.05
1972	130	2.73
1971	127.50	2.68
1970	127.50	2.68

Zoned discounts. Since early 1985, zoned rebates have been offered based on shipping distance from mills. Because most linerboard mills are located in the South, net transaction prices in parts of the Midwest and Texas have been about $10/ton below list and $20/ton in the Southeast. Before 1985, the rebates were $5 and $10/ton respectively.

A premium of $10/ton on linerboard west of the Rockies disappeared at the end of 1985. During 1980-81, western linerboard sold at a $30/ton premium due to high chip costs.

Basis-weight differentials. Based on the current 42-lb list price of $410, upcharges for other weights were as follows: 26-lb, plus $50 to $55/ton; 33-lb, plus $25 to $30/ton; 38-lb, plus $5 to $10/ton; 69-lb, same as 42-lb; 90-lb, plus $10/ton.

Specialty grades. New list price for 42-lb mottled white linerboard is $525, with 33-lb ranging from $575 to $595 and 69-lb from $500 to $510. Upcharge for wet-strength grades is about $20/ton.

* Indicates some discounting from transaction levels.

** Producers raised list price by $30/ton to $410 in March 1988.

Despite recent merger activity, the U.S. industry is still fragmented with 22 individual linerboard producers. The five largest producers account for about 45% of U.S. linerboard capacity (vs 34% in 1980), and the ten largest have 71% of the market (vs 58%). Stone Container Corp., now the largest U.S. producer with a 14% market share, rose from No. 16 in 1980. Four new companies emerged among the ten largest producers during this time span, while five disappeared from the industry altogether through mergers.

Another trend is an increase in the level of the industry's integration as companies tried to protect themselves from sharp downturns in the linerboard market. The most dramatic example of this was Great Northern Nekoosa's purchase of a large independent converter (J&J Corrugated Box) and then O-I's Forest Products Div. Before that, the company's Great Southern division was completely nonintegrated. The largest net sellers of linerboard are now believed to be International Paper, Great Northern Nekoosa, Union Camp, and Stone Container Corp.

INTERNATIONAL MARKETS

U.S. linerboard exports in 1987 rose 5.4% to 2.29 million short tons, second only to the record 2.5 million tons exported in 1980. "The very strong worldwide demand coupled with tight supply, plus the lower U.S. dollar, contributed to the sharp rise in the value of U.S. kraft linerboard exports—up 27.7% to a record $811.5 million," said Irene Meister, vice president-international, API.

The mix of U.S. linerboard exports in 1987 continued to shift to Far East markets, according to API's annual report on linerboard exports (based on Dept. of Commerce statistics). The Far East, including People's Rep. China, accounted for 40% of U.S. linerboard exports, up from 37% in 1986 and from less than 10% in 1977. In 1987, People's Rep. China increased its imports of U.S. linerboard by 56% to 284,000 tons, making that country the single largest market for U.S. linerboard. At the same time, U.S. exports to western Europe declined to 26% in 1987 from 29.2% in 1986. This is down from 40% a decade ago and from more than 50% in the early 1970s.

Western Europe. U.S. linerboard shipments to western Europe in 1987 declined by 6.2% to 597,000 tons in 1987, their second-lowest level in the past dozen years. While European box shipments remained strong in 1987, up about 6%, Nordic and some nontraditional kraft linerboard suppliers as well as local testliner producers strengthened their market positions. Shipments from Sweden to Western Europe rose 7.7% to 1.1 million tons, and shipments from Finland increased by 12.2% to 253,550 tons. Brazil increased its shipments to Europe by 19.5% to 186,270 tons. Total western European kraft linerboard imports from nine major supplying countries tracked by API's annual export report rose by 4.5% in 1987 to 2.6 million tons (not including such countries as the U.S.S.R., France, and South Africa, which in 1986 accounted for more than 270,000 tons).

Testliner producers increased their market share in 1987 due also to low wastepaper costs and rising kraft linerboard prices. The share of the European Community (EC) containerboard market held by testliner increased to between 22% and 23% from 17% in 1980. Kraft linerboard's share of the market declined from about 25% at the beginning of the decade to around 20%, according to estimates presented by Jan Carlström, director of SCANPAPP, at *Pulp & Paper's* Third International Unbleached Kraft Linerboard Conference in November 1986.

The large number of kraft linerboard suppliers and growing local competition from testliner producers have made the European market highly competitive. Prices crashed in 1985 due to high inventories and the strong dollar, with transaction levels dropping below the $333/metric ton minimum antidumping price (in the case of 175-g+ board) imposed by the EC Commission in 1983 after an earlier market downturn. Prices as low as $260 to $290/metric ton c.i.f. made it difficult for U.S. producers to compete on both economic and legal grounds. Prices then began to recover in the second quarter of 1986 and strengthened through 1987.

The latest $45/ton increase in the spring of 1988 took U.S. list levels in Europe to about $525/$550/$570 for heavy (175-g+), medium (150-g) and lightweight (125-g) linerboard before 6% duty. Nordic producers in late spring withdrew rebates from their local currency list prices (e.g., DM1,025/metric ton in West Germany). When announced, this level would have been similar to the U.S. price after duty. However, recent strengthening of the U.S. dollar pushed Nordic local currency prices below the dollar price in Europe. As a result, Nordic mills may try to pull up local currency prices in the fall of 1988.

Although no large, new kraft linerboard machines have been announced in Europe, a number of major producers have rebuilds under way or recently completed. These include ASSI (Sweden), Cellulose du Pin (France) and Portucel (Portugal). Test and other recycled containerboard capacity is expected to increase at an even faster rate, with a number of new machines and rebuilds planned along with reactivation of idle capacity. This will probably limit growth of U.S. linerboard exports to western Europe. Nordic mills also increased capacity to produce bleached or white-top linerboard for improved graphic display. Sweden's total bleached exports in 1987 jumped 15.9% to 197,800 tons, while Finland's rose 30.1% to 93,840 tons.

Southeast Asia. U.S. kraft linerboard exports to the Far East and Oceania (including People's Rep. China) in 1987 rose by 15% to 918,000 tons, following a 40% increase to 798,000 tons in 1986. While shipments to People's Rep. China increased sharply, exports to Japan and the rest of Southeast Asia were flat. The U.S. is the largest kraft linerboard exporter to this region, followed by Canada, which shipped 107,000 tons to the Far East in 1987.

Prices in the Southeast Asian markets have strengthened from depressed levels reached in 1985. U.S. producers in the spring of 1988 announced new list prices of $525/$550/$570 per metric ton c.i.f. for such markets as Singapore and Malaysia. (Prices in Hong Kong and Taiwan are about $10 to $15/ton less due to lower shipping costs.) Prices in the region tend to be volatile because some U.S. mills use it as a dumping ground during periods of domestic oversupply. As irregular sellers entered the market with low spot offers, price levels for lightweight linerboard dropped to between $260 and $270/ton in 1985.

The strong economic growth of the industrializing Asian countries, led by the "Four Tigers," should result in rising future demand for U.S. linerboard exports. However, countries such as Taiwan and Rep. Korea have expanding testliner industries.

MANUFACTURING COST AND PROFITABILITY TRENDS FOR AVERAGE U.S. SOUTHERN LINERBOARD MILL

($/short ton)

	1988	1987	1986	1985	1984
Average price[1]	$403	$361	$295	$274	$320
Fiber	107	103	98	106	113
Energy	23	24	24	32	34
Labor	36	36	36	35	35
Chemicals	14	14	14	15	15
Other	18	17	16	17	17
Delivery	33	32	32	32	32
Total variable costs	231	224	220	237	247
Depreciation	26	25	24	23	21
Interest	19	18	18	17	15
Overhead	16	16	16	15	15
Total costs[2]	292	283	278	292	299
Pretax profit[1]	111	78	17	(18)	21

Sources: 1. *Pulp & Paper* estimates. 2. Cost estimates from Resource Information Systems Inc. (RISI), *World Kraftliner Study*.

EXPORTS OF KRAFT LINERBOARD BY MAJOR SUPPLYING COUNTRIES

(000 short tons)

	1987	1986	1985	% change 1987/86
U.S.	2,295	2,177	1,807	5.4
Sweden	1,196	1,111	1,147	7.6
Canada	311	347	290	−10.4
Finland	284	244	262	16.4
Brazil	234	208	154	12.5
Portugal	126	149	151	−15.1
Austria	122	109	102	11.6
Norway	55	42	20	30.9
Spain	43	39	39	11.0
Total	4,666	4,426	3,972	5.4

Source: American Paper Institute—International Div., *Exports of Kraft Linerboard & Corrugating Material.*

Japan. U.S. linerboard exports to Japan in 1987 rose only 0.5% to about 164,000 tons, despite relatively healthy domestic corrugated box shipments and government policy aimed at increasing imports. The Japanese market is suffering from domestic overcapacity, and the price of K_2 linerboard (the most common grade, containing about 40% wastepaper) has flattened or declined for several years despite healthy corrugated box production. This keeps pressure on export prices, making Japan a less attractive market for U.S. suppliers. The price of heavyweight kraft linerboard in Japan in the summer of 1988 was reported to be around $465 to $475/metric ton c.i.f.

Prices in the Japanese market tend to be more stable because of special quality requirements and long-term business relationships that make it difficult for spot sellers to enter the market. Weyerhaeuser Co. is the largest exporter to Japan, setting up a warehouse system and selling liner in yen delivered to Japanese customers. Eurocan Pulp & Paper Co. Ltd.'s Kitimat, B.C., mill and Champion International Corp.'s Tacoma, Wash., mill are also regular suppliers. In addition, Stone Container Corp. recently established a marketing office in Japan.

U.S. KRAFT LINERBOARD EXPORTS BY WORLD REGION

(000 short tons)[1]

	Total[2,3]	Western Europe	Far East/ Oceania	People's Rep. China	Central America/ Mexico	South America	Caribbean/ other islands	Canada	Middle East	Africa
1987	2,295	597	633	284	275	123	56	44	145	91
1986	2,177	636	616	182	265	130	68	42	142	87
1985	1,807	511	460	110	250	122	56	40	137	107
1984	2,058	712	495	110	321	135	66	37	143	110
1983	2,255	761	501	166	276	110	74	48	151	108
1982	1,886	644	372	111	264	133	54	48	112	149
1981	1,973	637	357	174	275	131	48	39	127	185
1980	2,527	919	411	319	337	130	46	26	99	241
1979	1,645	711	264	11	278	110	45	55	101	70
1978	1,540	623	199	3	270	146	72	39	107	80
1977	1,428	607	120	22	238	133	67	30	118	93
1976	1,419	618	116	—	235	91	63	73	112	111
1975	1,224	522	73	—	171	121	38	65	142	91
1974	1,743	927	116	5	204	139	52	41	107	150
1973	1,646	862	141	17	237	138	43	19	79	108
1972	1,877	1,073	152	—	244	137	58	19	99	96
1971	1,966	1,166	142	—	247	148	44	17	100	101
1970	1,761	1,016	104	—	238	148	40	19	95	101

1. Includes "bleached" linerboard exports of 100,000 to 140,000 tons in recent years (most of this is believed to be unbleached mottled board that has been misclassified).
2. Totals may include some unallocated shipment not shown in regional breakdown; 57,000 tons were exported to the U.S.S.R. and eastern Europe in 1977.
3. Some variation exists between Dept. of Commerce and API production-for-export statistics, which were as follows (000 tons): 1987, 2,268; 1986, 2,246; 1985, 1,830; 1984, 2,086.

Source: American Paper Institute (from Dept. of Commerce data).

U.S. linerboard exports to Japan are expected to increase because of higher production costs in Japan due to high fiber and energy costs. Nevertheless, an earlier Ministry of International Trade and Industry (MITI) projection that containerboard imports from all sources will rise from 176,000 tons in 1979 to 560,000 tons by 1990 appears unlikely. Under pressure from the U.S. government, Japan is reducing its tariffs on imported linerboard.

People's Rep. China. The wild card in the U.S. linerboard export picture is People's Rep. China, which has become the single largest importing country. As previously mentioned, U.S. shipments in 1987 increased 54% to 284,000 tons, second only to the record 319,000 tons shipped to People's Rep. China in 1980 when the Chinese first began to make major purchases. Since then, Chinese buying comes in surges, with shipments in the weakest years dropping to only around 110,000 tons. The buying surges reflect inventory cycles in People's Rep. China and attempts to buy at the lowest prices in the U.S. market.

Orders from People's Rep. China fell off in the second half of 1987 and remained weak through the first half of 1988. Chinese were reportedly buying linerboard in the second quarter of 1988 at around $415 to $425/metric ton c.i.f. Most observers, however, expect the Chinese to step up orders in the second half of 1988 due to depleted inventories and another attempt to raise U.S. domestic market prices in early 1989. The long-term outlook for U.S. linerboard exports to People's Rep. China is positive because of that country's strong economic growth (recently running at about 9%/year), its drive to increase exports, and its limited wood resources. All kraft linerboard imported into People's Rep. China is used for packaging export products. The country imports linerboard through China Pack and Ministry of Light Industries. International Paper is believed to be the largest U.S. exporter to the country.

U.S. EXPORT LINERBOARD PRICES VS TESTLINER IN NORTHERN EUROPE

	U.S. kraft linerboard c.i.f., duty unpaid		Testliner no. 2 delivered Germany
	175 g + ($/metric ton)[1]	+ 36 lb ($/short ton)	150 g (DM/metric ton)
1987			
4Q	$485	(435)	DM 650/670
3Q	485	(435)	650/670
2Q	440	(399)	640/660
1Q	405	(367)	610/630
1986			
4Q	405	(367)	620/650
3Q	370/405	(336/367)	660
2Q	370	(336)	700
1Q	290/310	(263/281)	700
Year-end			
1985	270/290	(245/263)	750
1984	370/405	(336/367)	890
1983	333*	(362)*	720
1982	300*	(272)*	670
1981	415	(376)	780
1980	380	(345)	750/925
1979	375	(340)	770
1978	280	(254)	560
1977	230*	(209)*	—
1976	255*	(231)*	—
1975	310*	(281)*	—
1974	350	(317)	—
1973	245	(222)	—
1972	170	(155)	—
1971	137	(125)	—

* Some tonnage being sold below main transaction price levels.

[1] U.S. producers raised prices to $530/$560/$585 per metric ton for heavy (175-g+), medium (150-g), and lightweight (125-g) linerboard in the spring of 1988 (before current 6% duty).

Source: *Pulp & Paper Week.*

Latin America. U.S. linerboard exports to Latin America rose 5.8% in 1987 to 500,000 tons. Despite continuing political and economic turmoil in many countries, Central America and Mexico—the largest market—increased U.S. imports by 17% to 321,000 tons. Shipments to South America, however, were down 5.2% to 123,000 tons, primarily reflecting a drop in shipments to Ecuador, which suffered economic dislocation from a major earthquake. Another 56,000 tons were shipped to Caribbean and other islands. U.S. export prices to Latin America tend to be more stable because of long-term contracts with major customers, such as banana and coffee growers.

The U.S. is the only supplier of any consequence to these markets. Brazil produced 817,000 tons in 1987 and exported 234,000 tons, but the country ships only a small amount of tonnage to other Latin American countries. In the future, countries such as Brazil, Chile, New Zealand,

WESTERN EUROPE'S KRAFT LINERBOARD SUPPLIERS

(000 short tons)

	1987	1986	1985
Sweden	1,115	1,035	1,040
Finland	254	226	194
Norway	45	35	19
Total Nordic	1,413	1,295	1,253
U.S.	597	636	511
Canada	139	133	105
Austria	117	103	95
Iberia	164	182	178
France	n.a.	118	86
Brazil	186	156	108
U.S.S.R.	n.a.	86	19
South Africa	n.a.	69	15

n.a. = Not available.

and Portugal—with large, fast-growing softwood resources—might become more important competitors in the linerboard export market.

Current U.S. linerboard industry prosperity appears likely to continue through most of 1989. Assuming even conservative growth in corrugated box shipments of 3% in 1988 and 1% in 1989, the industry should be able to achieve a high level of operating rates.

Operating rates should average 98% to 99% in 1988 and 96% to 97% in 1989 based on an adjusted capacity base (to reflect about 250,000 tons of additional capacity in 1988 and 300,000 tons in 1989 from incremental expansion and kraft paper swing capacity). Linerboard exports are expected to take up any slack that develops in the domestic market, as long as the U.S. dollar remains weak. Based on this scenario, an industry move to raise linerboard prices by $30 to $40/ton in early 1989 appears likely to succeed.

This would raise price levels high enough to justify some major kraft linerboard expansion projects, as well as make incremental and recycled linerboard expansion irresistible. Uncertainty about the future direction of the kraft paper market, growing delivery times at heavily backlogged machinery suppliers (reportedly two years to order a popular high-pressure press), and an engineering shortage may restrain capacity growth and help save the industry from itself. An economic slowdown or recession expected by most economists for the second half of 1989 or 1990 would probably cause some softening in prices, but it should be fairly moderate compared to the last industry downturn in 1985 as long as the dollar remains weak.

Profitability for the U.S. kraft linerboard industry will probably be higher in the 1990s than during the past decade. Positives for the industry include stronger industry leadership and concentration; development of new, higher value-added grades (high-strength and white-top board); and strong growth in kraft linerboard import demand from People's Rep. China, Japan, and other Far East countries. The move toward more performance-oriented products should help keep containerboard and corrugated boxes more competitive with plastic packaging.

U.S. linerboard exporters are likely to face more competition from nontraditional producing countries with substantial softwood resources, such as Brazil, Chile, New Zealand, and South Africa. Recycled linerboard is also expected to increase its share of the U.S. and world containerboard markets at the expense of kraft linerboard. However, some kraft linerboard producers will also become major testliner producers, as Temple-Inland has done in the U.S. and as Svenska Cellulosa has done in Europe through the recent purchase of a major Italian testliner producer.

U.S. EXPORT LINERBOARD PRICES IN ASIA

	Southeast Asia 125 g ($/metric ton c.i.f.)[1]	People's Rep. China ($/metric ton f.a.s.)[2]	Japan 175 g+ ($/metric ton c.i.f.)[3]	Japan Domestic K_2 (¥/kg delivered)[4]
1987				
4Q	$530	$422	$450	¥80
3Q	500/530	391	420/450	80
2Q	500	367	420	80
1Q	485/500	358	390	78
1986				
4Q	440/455	332	380	75
3Q	420/435	308	370	80
2Q	350	219	350	85/87
1Q	280	203	320	85
Year-end				
1985	270*	208	—	85
1984	380	326	—	124/125
1983	365	222	—	118/120
1982	—	207	—	119/129
1981	—	280	—	133/140
1980	—	326	—	137

1. Prices for Singapore/Malaysia. List was raised to $570 in spring of 1988. Levels in Hong Kong typically $10/ton lower due to freight cost.
2. Average value per ton of exports calculated from Dept. of Commerce data.
3. Prices from regular U.S. suppliers.
4. K_2 contains about 40% wastepaper and has become the most important liner grade produced by Japanese mills.

Source: *Pulp & Paper Pricebook.*

1987 KRAFTLINER EXPORTS FROM MAJOR PRODUCING COUNTRIES

(000 tons)

Major importers	Exporter				
EUROPE	U.S.	Canada	Sweden	Finland	Norway
Austria	1	—	17	1	—
Belgium	6	75	53	14	2
Denmark	1	—	75	19	2
Finland	—	—	17	—	2
France	11	0	179	28	—
Germany, Fed. Rep.	102	3	177	51	12
Greece	4	—	8	2	—
Ireland	—	—	32	6	—
Italy	112	—	52	4	—
Netherlands	34	—	73	22	3
Norway	1	0	33	4	—
Spain	47	—	1	10	—
Sweden	3	—	—	4	1
Switzerland	—	1	23	2	—
U.K.	192	47	266	60	17
Other	27	—	9	4	1
Total Europe	541	126	1,015	231	40
NORTH AMERICA					
Canada	40	—	—	—	—
U.S.	—	53	—	0	—
Total North America	40	53	—	—	—
ASIA/AUSTRALASIA					
Australia	37	—	—	—	—
China	258	30	19	11	—
Hong Kong	128	8	—	2	—
Iran	—	—	—	—	—
Israel	74	—	5	7	1
Japan	151	37	—	—	—
Korea, Rep.	36	12	1	0	—
Malaysia	—	0	1	0	—
Philippines	—	2	—	—	—
Singapore	—	7	2	0	—
Taiwan	42	2	—	—	—
Other	237	—	20	5	4
Total Asia/Australasia	964	98	48	25	5
LATIN AMERICA					
Argentina	5	—	—	—	—
Colombia	60	—	—	—	—
Guatemala	—	—	—	—	—
Mexico	46	—	—	—	—
Venezuela	6	—	—	—	—
Other	348	5	3	0	1
Total Latin America	454	5	3	—	1
AFRICA					
Egypt	22	—	—	—	2
Morocco	—	—	8	0	—
Nigeria	—	—	1	—	—
South Africa	11	—	—	—	—
Other	49	—	10	2	1
Total Africa	83	—	19	2	3
WORLD TOTAL	2,082	282	1,085	258	50

Source: *Pulp & Paper International,* Annual Review, July 1988.

CORRUGATING MEDIUM

U.S. STATISTICS FOR CORRUGATING MEDIUM

(000 short tons)

	1989e	1988e	1987
Production			
Semichemical	5,810	5,700	5,606
Recycled	1,780	1,760	1,640
Total	7,590	7,460	7,246
Capacity[1] (adjusted)			
Semichemical	6,013	5,811	5,641
Recycled	1,914	1,827	1,666
Utilization rates[1], %			
Semichemical	96.6	98.1	99.4
Recycled	93.0	96.3	98.4
Imports[2]	145	140	129
Exports	65	55	64
Apparent U.S. consumption			
000 tons	7,670	7,545	7,311
lb/capita	62.0	61.5	60.2
000 tons/$ billion real GNP	1.91	1.92	1.91

e = Estimate.

[1] American Paper Institute November 1987 capacity survey figures have been revised upward to reflect reactivation or conversion of machines, additional incremental expansion activity, and operating improvements. Semichemical: 100,000 tons and 150,000 tons have been added to the 5.711 and 5.863 million tons originally estimated for 1988 and 1989 respectively. Recycled: 75,000 and 150,000 have been added to the 1.752 million and 1.764 million tons planned for 1988 and 1989.

[2] Dept. of Commerce data.

Corrugating medium is used to form the central or middle fluting material in corrugated containerboard. It is first fluted or corrugated in a corrugator, then faced on both sides with linerboard to form the rigid combined board.

Corrugating medium includes paperboard made from both semichemical pulp and recycled fiber. In 1987, 77% of U.S. corrugating medium was made from a semichemical pulp furnish, while 23%, called "bogus" medium, was produced from recycled fiber. Basis weights of corrugating medium are 22, 26, 31, 33, 36, and 40 lb/1,000 ft^2.

Semichemical corrugating medium is made primarily from hardwoods, but some western mills use softwood species. Softwood sawdust is also used. Nearly all types of hardwood species are used, but some semichemical mills find it difficult to pulp certain species such as white oak. Semichemical medium is normally manufactured on conventional fourdrinier paper machines, but a small percentage is produced on cylinder board machines. A couple of mills in Wisconsin and Virginia produce medium using twin-wire formers.

Semichemical medium contains some long fiber to improve paper machine runability and also to lessen the tendency of the medium to crack and break upon corrugating. The principal sources of long fiber are waste corrugated containers and new double-lined kraft cuttings. The amount of secondary fiber used varies from none to 50%, but average wastepaper content is close to 31%. In some cases, screenings from kraft mills or kraft softwood pulp is used as the source of long fiber.

Semichemical pulping combines a mild chemical pulping of chips prior to mechanical defibrating and produces a fairly high yield, 60% to 80%, as well as an intermediate strength level. Neutral sulfite semichemical (NSSC), developed in the 1920s, was the original semichemical pulping process. Chemicals used include sodium sulfite and soda ash, and pulping was initially performed using rotary batch digesters. Most semichemical mills now use continuous digesters, and there has been a shift from NSSC to the newer carbonate-base and green-liquor semichemical pulping processes.

More than 60% of U.S. semichemical mills have shifted from NSSC to the Owens-Illinois nonsulfur and green-liquor processes. These processes, developed since the 1960s, are simpler and less capital-intensive, and they have fewer pollution problems. The O-I process uses soda ash (sodium carbonate) and a small amount of caustic soda, and it is adaptable to existing stand-alone semichemical mills with only minor equipment modifications.

Green-liquor semichemical pulping uses kraft green liquor; therefore, the process can be used only in combination with a kraft mill. Such cross-recovery reduces chemical processing and recovery and minimizes capital costs. Both the O-I and green-liquor processes produce a semichemical pulp comparable in quality to NSSC, except for a darker color. Wetting agents, however, must be added to the refined stock to control glue absorption in the finished board.

Mills producing corrugating medium from 100% wastepaper (bogus medium) use primarily old corrugated containers as a source of fiber. Because waste corrugated containers contain foreign materials (tape, hot melts, latexes, asphalt, waxes, etc.) mills use cleaning equipment on the stock to remove contaminants. To improve the strength of bogus medium, a number of additives are used—typically, modified starches and gums. At 5- to 10-lb/ton, these additives can improve concora (strength) by 10% to 20%.

The principal test used to judge the strength of corrugating medium is the concora test. Concora is controlled by refining and by choice of fiber types. Typical concora values for standard basis weights are 60 to 70 lb for 26-lb medium and 70 to 90 lb for 33-lb medium.

The bulk of semichemical medium is still produced at 26 lb/1,000 ft², but the trend is toward heavier weights. Heavy weights from 36 to 40 lb and higher now account for about 8% of total semichemical production, up from virtually nothing at the beginning of the decade. This reflects an industry move toward more performance-oriented corrugated packaging emphasizing top-to-bottom compression strength in finished boxes (see Linerboard and Converted Products sections). Compression strength requirements can be met using lower basis-weight linerboard and heavier-weight corrugating medium, resulting in reduced fiber costs.

Wet-strength grades have grown in popularity (mainly in 33-, 36-, and 40-lb weights) and now account for about 5% of semichemical medium production. Corrugating medium for conventional use is not sized. Hard sizing would interfere with starch gluing and result in poor adhesion between liner and medium.

About 40 semichemical medium mills are located

ANNUAL U.S. CAPACITY FOR CORRUGATING MEDIUM

(000 short tons)

	Semi-chemical	Recycled	Total	% change
1990e	5,934	1,774	7,708	6.1%
1989e	5,863	1,764	7,627	2.2
1988e	5,711	1,752	7,463	2.1
1987	5,641	1,666	7,307	2.4
1986	5,557	1,580	7,137	2.9
1985	5,411	1,523	6,934	2.3
1984	5,252	1,524	6,776	1.0
1983	5,156	1,555	6,711	0.4
1982	5,207	1,478	6,685	5.5
1981	4,988	1,349	6,337	1.0
1980	4,946	1,330	6,276	0.3
1979	4,864	1,392	6,256	2.8
1978	4,739	1,343	6,082	1.4
1977	4,661	1,337	5,998	–3.8
1976	4,758	1,476	6,234	4.2
1975	4,536	1,449	5,985	3.5
1974	4,430	1,358	5,788	4.0
1973	4,386	1,178	5,564	6.6
1972	4,155	1,063	5,218	5.6
1971	3,938	1,000	4,938	2.2
1970	3,847	983	4,830	—

e = Estimate.

Source: American Paper Institute.

throughout the U.S., with about one third of total industry capacity in the upper Midwest hardwood region. Most Canadian capacity is located in the eastern and Maritime provinces, and some of these mills ship down into the northeastern U.S. Recycled medium mills are usually located in major urban areas, near wastepaper supplies and major box markets, giving them an advantage in transportation costs.

PRODUCTION/CAPACITY TRENDS

Production of corrugating medium generally follows that of linerboard, with about one ton of medium currently used for every 2.16 tons of liner in producing corrugated containers (see Linerboard section).

Production of corrugating medium rose about 5.8% in 1987 to 7.3 million tons, reflecting a 4.9% increase in corrugated box shipments. Semichemical medium production rose 4.7% to 5.6 million tons, while recycled medium jumped 7.4% to 1.7 million tons. The market for corrugating medium became tight during the second half of 1987 due to strong growth in corrugated box cutup combined with only limited capacity expansion for semichemical medium.

Semichemical medium capacity increased at only a 1.8% rate during the 1986-88 period, according to the American Paper Institute 1987 capacity survey. As a result, recycled medium and imports have had to help fill the supply gap. Imports of medium (mainly from Canada) in 1987 jumped nearly 30% to 129,000 tons. U.S. semichemical medium mills ran at 99% of capacity in 1987, while recycled mills did almost as well at 98%. Contributing to the tight market was Willamette Inc.'s decision to convert a medium machine to linerboard in 1986 at its Albany, Ore., mill.

Prices for corrugating medium slid sharply in the 1985 containerboard market downturn, even though semichemical medium mills continued to run at about 94% of capacity. Semichemical medium prices reached as low as $230 to $240/short ton in 1985, which was below break-even for many mills. Prices began to firm in 1986, although producers had difficulty restoring their normal $10/ton differential with kraft linerboard. About a $20 to $30/ton gap between the two grades persisted through 1986 and 1987, but it has gradually diminished.

Semichemical medium producers last raised prices by $30/ton to a $400 list in March of 1987, with transaction prices averaging about $390. (The differential between linerboard and medium prices is clouded by the industry practice of offering zoned rebates of $10 and $20/ton based on shipping distance from the mill. As noted earlier, most linerboard mills are located in the Southeast, while medium mills are scattered throughout the U.S. and therefore within a shorter shipping distance of customers.)

ANNUAL U.S. PRODUCTION OF CORRUGATING MEDIUM

(000 short tons)

	Semi-chemical[1]	Recycled[2,3]	Total	% change
1987	5,605	1,678	7,283	4.9%
1986	5,373	1,568	6,941	5.5
1985	5,088	1,486	6,574	0.1
1984	5,169	1,397	6,566	4.6
1983	4,731	1,545	6,276	7.9
1982	4,389	1,427	5,416	3.6
1981	4,717	1,315	6,032	0.5
1980	4,723	1,281	6,004	0.2
1979	4,689	1,301	5,990	2.4
1978	4,439	1,408	5,847	5.4
1977	4,264	1,286	5,550	7.8
1976	4,105	1,040	5,145	14.6
1975	3,702	788	4,490	–15.1
1974	4,175	1,115	5,290	–3.2
1973	4,260	1,204	5,464	10.3
1972	4,010	942	4,952	8.1
1971	3,700	879	4,579	3.7
1970	3,500	916	4,416	—

1. Source: American Paper Institute.
2. Source: Dept. of Commerce.
3. Production for domestic use (API data—000 tons): 1980, 1,047; 1981, 1,141; 1982, 1,139; 1983, 1,305; 1984, 1,385; 1985, 1,359; 1986, 1,551.

CAPACITY RANKINGS OF U.S. CORRUGATING MEDIUM PRODUCERS

(000 short tons)

	Annual capacity			
	Semi-chemical medium	Recycled medium	Total	Capacity share %
1. Great Northern Nekoosa	935[1]	—	935	12.5%
2. Stone Container	675	180	855	11.5
3. Weyerhaeuser	685	—	685	9.2
4. Temple-Inland	205	275	480	6.4
5. Jefferson Smurfit	58[2]	305[2]	363	4.9
6. International Paper	350	—	350	4.7
7. Mead	335	—	335	4.5
8. Georgia-Pacific	280[3]	—	280	3.7
9. Packaging Corp. of America	270	—	270	3.6
10. Virginia Fibre	265	—	265	3.6
11. Willamette Industries	115[4]	140	255	3.4
12. MacMillan Bloedel	250	—	250	3.3
13. Menasha	185	—	185	2.5
14. Weston Paper	150	—	150	2.0
15. Waldorf	—	140	140	1.9
16. Green Bay Packaging	135	—	135	1.8
17. Chesapeake	—	125	125	1.7
18. Manville Forest Products	120	—	120	1.6
19. Gaylord Container	80	35	115	1.5
20. Boise Cascade	110	—	110	1.5
21. Clinch River	105[5]	—	105	1.4
22. Groveton Paper Board	105[6]	—	105	1.4
23. Westvaco	100	—	100	1.3
24. Consolidated Packaging	75	—	75	1.0
25. Grief Board	—	75	75	1.0
26. Dixie Container	—	73	73	1.0
27. Longview Fibre	70	—	70	0.9
28. Cascades	—	70[7]	70	0.9
29. Corrugated Services	—	50	50	0.7
30. Connelly Containers	—	40	40	0.6
31. Newark Boxboard	—	35	35	0.5
32. Menominee	—	30	30	0.4

U.S. capacity (1988): 7.463 million short tons
Market share of top 5 companies: 44.5%
Market share of top 10 companies: 64.6%

Other mills that make small quantities of recycled medium include: Cleaners Hanger Co., Cornwall Paper Mills Co., Forestales Caribe Inc. (Puerto Rico—subsidiary of Nolichucky Industries), and Specialty Paper Mills Inc.

1. Includes Great Southern Paper and Nekoosa Packaging (717,000 tpy semichemical medium) acquired from Owens-Illinois Inc. in 1987.
2. Includes 50% interest in Container Corp. of America mills (115,000 tpy semichemical and 172,000 tpy recycled medium) acquired in 1986.
3. Includes 50% interest in 170,000-tpy semichemical medium machine at Sonoco Products Co.'s Hartsville, S.C., mill; G-P takes the production.
4. Reflects conversion of medium machine to linerboard at Willamette's Albany, Ore., mill in 1987.
5. New company that acquired and reactivated former Harriman Paper Board mill in Harriman, Tenn., in mid-1988.
6. Owned 31% by Jefferson Smurfit and 69% by SPB Canada; machine operated by James River Corp.
7. Cascades acquired former Nitec Paper mill in Niagara, N.Y., and in 1988 converted two machines to recycled medium.

INDUSTRY STRUCTURE

The corrugating medium market tends to be more competitive and regionalized than the linerboard industry. This reflects a larger number of small producers scattered across the U.S. More than 32 U.S. companies produce semichemical or recycled medium, with the five largest accounting for 45% of total industry capacity. By contrast, there are 22 linerboard producers, of which the five largest have 57% of the market.

The cost profiles of corrugating medium producers show greater range, reflecting wider variation in mill size and fiber furnish costs. About one third of U.S. semichemical medium capacity is represented by machines that produce 125,000 tpy or less. At the same time, two U.S. semichemical machines have a capacity to produce over 300,000 tpy. Nekoosa Packaging's Tomahawk, Wis., mill and Mead Corp.'s Stevenson, Ala., mill are examples of two of the most efficient medium mills.

Recycled mills tend to be older and less efficient, but they may have an advantage when wastepaper costs are low. Imports of Canadian and Mexican medium have also added a competitive element in the northeastern and southwestern markets.

INDUSTRY OUTLOOK

Corrugated box shipments are expected to rise about 3.4% in 1988, followed by a 1.5% increase in 1989 reflecting a high level of U.S. manufacturing activity due to the weak dollar. Total medium production in 1988 is expected to rise nearly 3% to 7.46 million tons. Semichemical medium output is forecast to rise 1.7% while recycled jumps 6.7%.

This would result in operating rates for semichemical medium mills of about 98% in 1988 and 97% in 1989, with recycled medium mills running at a slightly lower rate. API 1987 capacity survey figures were adjusted slightly upward to reflect reactivation of idle mills, incremental expansion activity, and operating improvements. (Semichemical capacity was adjusted up by 100,000 tons in 1988 to 5.81 million tons and by 150,000 tons to 6.0 million tons in 1989. Recycled medium capacity was increased by 75,000 tons to 1.83 million tons in 1988 and by 150,000 tons to 1.914 million tons in 1989.)

Clinch River Corp. recently restarted the 300-tpd semichemical medium mill at Harriman, Tenn., and Cascades Inc. restarted two machines at the former Nitec Paper mill in Niagara, N.Y., on recycled medium. Nolichucky Industries plans to restart the former James River fine paper mill in Hyde Park, Mass., producing recycled medium in 1988.

Green Bay Packaging Inc. recently announced plans to increase capacity of its Green Bay, Wis., medium mill from 400 to 700 tpd, and Virginia Fibre plans to expand capacity at its 730-tpd Riverville, Va., mill in phases over the next several years. Jefferson Smurfit is also studying possible reactivation of an idle machine to produce recycled containerboard at its Fernandina Beach, Fla., mill.

The long-term outlook for corrugating medium appears

MAJOR U.S. CORRUGATING MEDIUM EXPANSION PROJECTS

Company	Mill location	Capacity (000 short tpy)	Startup date
Announced			
Cascades*	Niagara, N.Y.[1]	70	1988
Clinch River	Harriman, Tenn.[2]	105	1988
Nolichucky*	Hyde Park, Mass.[3]	65	1988
Corrugated Services*	Forney, Texas	41	1989
Great Northern Nekoosa	Cedar Springs, Ga.	40	1989
Green Bay Packaging	Green Bay, Wis.	105	1989
Stone Container*	Uncasville, Conn.	60	1989
Virginia Fibre	Riverville, Va.	165	1989-91
Great Northern Nekoosa	Tomahawk, Wis.	80	1990
Weyerhaeuser	Valliant, Okla.	55	1990
Proposed			
Jefferson Smurfit*	Fernandina Beach, Fla.	210[4]	n.a.

* Recycled medium.

n.a. = Not available.

1. Cascades acquired the former Nitec Paper mill and converted two machines to production of recycled medium.
2. New company that acquired and restarted idle Harriman Paperboard mill in June 1988; mill had been idle since late 1985.
3. Nolichucky Industries recently acquired the former James River fine paper mill and plans to reactivate it producing recycled medium.
4. Smurfit is studying reactivation of idle medium machine at Fernandina Beach; machine would produce both recycled linerboard and medium.

bright if the trend to higher basis weights and more performance-oriented corrugated packaging continues to grow. Higher growth in medium capacity, however, may become a problem as more mills install high-pressure presses (see Linerboard chapter) and as a number of older recycled paperboard mills are reactivated or converted from other grades to medium production. At least two U.S. semichemical medium mills have installed wide-nip presses, and several other projects are planned.

CANADIAN CONTAINERBOARD MARKET

The Canadian containerboard industry (both linerboard and medium, including recycled) is much smaller than the U.S. industry, with production of about 2.0 million short tons compared to about 25 million tons for the U.S. This reflects the fact that the Canadian industry serves mainly the domestic market, which has a population of only 25 million and an economy about one-twelfth the size of the U.S. economy.

The Canadian containerboard industry developed behind high tariff walls, and many of its facilities are not competitive in size or scale with mills in the U.S. The higher cost structure for the Canadian industry also reflects the fact that linerboard is a fiber-intensive grade, while the growing cycle for wood in northeastern Canada is slow and harvesting and transportation costs are high. Until 1980, a 15% tariff protected the containerboard industry; under GATT negotiations completed in the late 1970s, this will drop to 6.5% by 1987 for kraft linerboard and 4% for corrugating medium. Staged reductions over the next five years will eliminate the tariffs by 1993.

The evolution toward a more open, internationally competitive market is painful for Canadian producers. Since 1977, three containerboard mills have closed—two export-oriented kraft linerboard mills (Labrador Linerboard and MacMillan Bloedel) and a recycled liner mill. In total, this took about 500,000 tpy of linerboard capacity out of the market, although production still showed some growth. During the 1977-86 period, production of linerboard in

CANADIAN CONTAINERBOARD PRODUCTION

(000 metric tons)

	Total container-board	Linerboard*	Corrugating medium*
1987e	1,850	1,195	655
1986e	1,773	1,163	610
1985	1,575	1,077	498
1984	1,591	1,023	568
1983	1,465	930	534
1982	1,305	876	429
1981	1,599	1,080	519
1980	1,571	1,113	458
1979	1,489	1,037	452
1978	1,419	1,010	409
1977	1,261	920	340
1976	1,294	950	344
1975	1,014	710	304
1974	1,512	1,091	420
1973	1,450	1,002	448
1972	1,254	839	414
1971	1,076	723	353
1970	1,042	704	339

e = Estimate.
* Includes some recycled paperboard.

Source: *Statistics Canada.*

U.S. PRICES FOR CORRUGATING MEDIUM

(semichemical, 26-lb, eastern U.S.)

	$/short ton	$/1,000 ft^2
1987†		
4Q	$350/360*	$4.55/4.68
3Q	330/340*	4.29/4.42
2Q	320/330*	4.16/4.29
1Q	320/330*	4.16/4.29
1986		
4Q	290/300*	3.77/3.90
3Q	290/300*	3.77/3.90
2Q	250/260*	3.38/3.51
1Q	240*	3.12
Year-end		
1985	240	3.12
1984	310	4.03
1983	280	3.64
1982	240*	3.12
1981	260*	3.38
1980	260	3.38
1979	240	3.12
1978	210	2.73
1977	180*	2.34
1976	200*	2.60
1975	190	2.47
1974	190	2.47
1973	140	1.82
1972	123	1.60
1971	120	1.56
1970	120	1.56

* Indicates some discounting.
† List price for 26-lb semichemical medium rose to $340 in March 1987 and to $370 in August 1987 and finally to $400 in March 1988. Transaction prices have been lower in most sections of the country, partly because of zoned discounts of $10 and $20/ton offered by many producers to customers within a certain shipping distance.
Price on West Coast has been $4.25/ton and higher, but premium disappeared in the 1984-85 market downturn. Recycled medium may sell at a slight discount ($10/ton) to semichemical medium, depending on quality.

Source: *Pulp & Paper Week.*

Canada increased from 917,000 tons to nearly 1.2 million tons. Corrugating medium grew at a faster rate, rising from 341,000 tons to 610,000 tons by 1986, according to Candian Pulp & Paper Assn. statistics.

The Canadian linerboard industry is based more heavily on secondary fiber, with recycled linerboard accounting for about 25% of total linerboard capacity (vs about 3% in the U.S.) However, recycled medium in Canada accounts for about 19% of total production, slightly lower than in the U.S.

The corrugated industry in Canada is almost totally integrated, with independents having well under 5% of the corrugated market (vs roughly 20% in the U.S.). Two integrated corrugated companies, Domtar Inc. and MacMillan-Bathurst Inc., account for more than half of the Canadian industry's box production. Canadian Pacific Forest Products ranks third with another 15% to 20% share of the market. In 1987, Canadian corrugated box shipments totaled 2.188 million m^2, up 3.4% from the previous year. Value of shipments was C$1.37 billion, up 11.8%, according to *Statistics Canada.*

More than 25% of both linerboard and medium production is shipped outside of Canada. (Eurocan Pulp & Paper Co. is the largest liner exporter, and Consolidated-Bathurst Inc. and Papier Cascades Inc. are the biggest medium exporters.) While imports of board are relatively small, imports of finished boxes have grown significantly. During 1982, a large part of the eastern Canadian corrugated industry was shut down by labor problems, and a number of U.S. box plants located near the border started shipping into Canada.

Canadian containerboard prices tend to follow those in the larger U.S. market, although they are at somewhat higher levels even after duty. Canadian producers last raised list prices Apr. 1, 1988, with kraft linerboard (42 lb) going up $35/ton to $675/metric ton and semichemical medium (26 lb) rising $30 to $630/metric ton. Reflecting the increase in raw material costs, Canadian corrugated box manufacturers raised prices by 5% to 6%.

Some industry experts doubt if another kraft linerboard mill will ever be built in Canada, although incremental expansion is taking place. The 1987 Canadian Pulp & Paper Assn. capacity survey showed kraft linerboard capacity remaining flat at about 940,000 metric tpy during the 1987-89 period while recycled linerboard capacity rises slightly to 312,000 tons. This does not include Eurocan Pulp & Paper Ltd.'s rebuild of a machine at its Kitimat, B.C., mill, which will add 105,000 tpy of capacity. (Pulping will be expanded through installation of a chemi-mechanical pulping system—a new type of pulp for manufacturing kraft linerboard.)

Semichemical medium is expected to show the most growth, rising from 532,000 tons in 1986 to 602,000 tons by 1989. This reflects mainly the installation of a new 150,000-metric-tpy machine at Consolidated-Bathurst's Matane, N.B., mill, which will replace two older existing machines when it starts up in 1988. Recycled medium is expected to decline slightly from 152,000 tons in 1987.

ESTIMATED CONTAINERBOARD CAPACITY OF MAJOR CANADIAN PRODUCERS

(000 metric tpy)

	Linerboard	Corrugating medium	Total containerboard
Domtar	270**	145**	415
Consolidated-Bathurst	200	160[1]	360
CIP	225	85	310
Eurocan	235[2]	—	235
Paperboard Industries[3]	85*	50*	135
Cascades	—	115**	115
Atlantic Packaging	60*	40*	100
Irving (Lake Utopia)	—	90	90
Kruger	90*	—	90
MacMillan Bloedel	—	70	70
Crown Forest	35	25	60

* Recycled containerboard.

** Includes some recycled containerboard capacity.

1. New 150,000-tpy machine being installed at Bathurst, N.B., mill replacing two older machines for 45,000-tpy net increase in 1988.
2. Rebuild will increase Kitimat, B.C., mill's capacity 105,000 tpy in 1989.
3. Includes Belkin Packaging acquired in 1987.

COATED AND UNCOATED KRAFT BOARD

Unbleached kraft paperboard other than linerboard is used for folding cartons and other miscellaneous purposes, and it competes primarily with solid bleached sulfate (SBS) and recycled paperboard grades. Comprising only 7% of the unbleached kraft paperboard market but 17% of the boxboard market (approximately one million short tons), this grade is also known as clay-coated linerboard, coated unbleached kraft, coated natural kraft, and the trademark solid unbleached sulfate (SUS).

"Folding" includes clay-coated unbleached kraft and bleached-lined unbleached kraft-backed paperboard for conversion into folding cartons and beverage carriers. More recently such clay-coated board has been used as preprinted linerboard for small corrugated containers used to package consumer products. Such boxes are used not only for shipping the product but also to serve as point-of-purchase displays in mass-merchandise outlets. "Other" includes uses for unbleached kraft board such as filler in shipping containers; tube, can, and drum stock; file folder; tag; and automobile panel. These miscellaneous uses are discussed at greater length in the section on converted products.

Much of the folding carton made from unbleached kraft board is used in beverage carriers for holding cans or bottles, such as six-packs for beer or soft drinks, plus a wide variety of food and other products. Carrier board is coated on-machine, normally with a clay coating over a calcium-carbonate precoat, and it is made on conventional and modified fourdriniers.

Carrier stock used in refrigerated applications is made with wet-strength additives in either the kraft furnish or the coating or both. Typically, carrier stock has a basis weight of about 84 lb/1,000 ft^2 and 410 g/m^2 and a caliper of 20 to 21 pt (0.020 to 0.021).

Unbleached kraft board is made from 100% unbleached sulfate pulp. It is strong and moisture resistant and has good printability, scoring, and folding properties. When coated, the board is usually available in caliper ranges from 0.014 to 0.030, in caliper points varying between 4.5 to 3.7 lb/1,000 ft^2, and in brightness standards from 70 to 80.

Manville Forest Products Corp. and Mead Corp. together produce nearly all of the U.S. supply of this grade. In 1987, Manville's SUS capacity was 640,000 tpy, which included Aqua-Kote, Aqua-Lite, KrafKote, TuffKote, and Pearl-Kote. Mead's capacity for grades it refers to as coated natural kraft (including Carton Kote, Carrier Kote, and Carrier Kote II) was approximately 400,000 tpy.

UNBLEACHED KRAFT PAPERBOARD CAPACITY FOR FOLDING CARTONS AND OTHER USES

(000 short tons)

	Folding cartons[1]	Other uses[2]
1990e	1,463	430
1989e	1,130	436
1988e	1,096	430
1987e	983	430
1986	946	501
1985	905	500
1984	792	477
1983	800	493
1982	860	509
1981	804	540
1980	852	529
1979	827	520
1978	650	540
1977	645	561
1976	595	525

e = Estimate.

1. Includes carrier board.
2. Includes tube, can and drum stock.

Source: American Paper Institute.

In Europe, this clay-coated grade competes with similar output from producers in Finland and Sweden (the Billerud AB and Papyrus Kopparfors AB divisions of Stora, ASSI [AB Statens Skogsindustrier], and Korsnäs-Marma AB).

In the uncoated unbleached kraft board line, Westvaco Corp. early in 1987 introduced its upgraded version of folding carton stock. Called Kraftpak, this low-density board was the first of its kind free of metal. Available in calipers from 13 to 30, it was reported to be denser than linerboard, approved for food packaging, and strong enough for institutional and other heavy-duty uses.

Unbleached kraft board benefited in 1986 from higher demand for nondurable end-use packaging, the most positive influence being a rise in packaging demand by the food and beverage sector. This accounted for about 55% of the value and 62% of the tonnage of folding cartons, including beverage carriers, shipped in 1985. Other improved end-use markets included sporting goods, candy, soap, and paper goods. At the same time, paperboard packaging demand from tobacco, cosmetics, medicinal products (including disposable diapers), and hardware manufacturers declined, according to the Dept. of Commerce.

About 52% of the industry's 1986 consumption of boxboard for folding carton manufacture was in the nonrecycled grades, up from 51% in 1985. Consumption of SBS, the principal woodpulp-based boxboard used (estimated at about 35% of total industry consumption) remained weak in 1986, but significantly greater use of unbleached kraft grades more than compensated for the loss, Dept. of Commerce figures indicated.

The growth in unbleached kraft demand has been relatively good compared with the overall boxboard business, improving at the rate of 8.8% during the 1960s and 4.6% during the 1970s—outperforming both SBS and clay-coated recycled grades.

Clay-coated unbleached kraft board usage in folding cartons and carriers has grown primarily because it offers considerable savings over SBS and because it is stronger than recycled board. Other industry statistics indicate that SBS usage in boxboard production declined at the rate of 0.8%/year for the period 1980-85. Kraft paperboard usage jumped over 10% in 1986, although it had dropped in 1985 and decreased an average of 1%/year between 1980 and 1985. Carrier board, however, was up over 5% in 1986.

In recent years, the folding carton market has been the most promising for coated unbleached kraft board producers, growing over the past several years from nothing to an estimated 9% of that market in 1986. Beverage carrier demand wavered in the early 1980s as beer consumption eased and as more beverages were bottled in two-liter plastic containers. But this market has been coming back, boosted by a heightened interest in better packaging graphics and the growth in such new products as wine coolers.

Bruce Kirk of Goldman Sachs & Co. estimated that

UNBLEACHED KRAFT PAPERBOARD PRODUCTION BY GRADE, 1968-86

(000 short tons)

Year	Container-board[1]	Box-board[2]	Tube/can	Other	Exports	Total
1986	14,157	889	164	234	2,245	17,689
1985	13,353	822	164	198	1,830	16,367
1984	13,950	752	192	205	2,086	17,185
1983	12,720	710	204	207	2,281	16,122
1982	11,563	691	193	157	1,931	14,535
1981	12,654	672	219	171	1,887	15,603
1980	11,852	680	226	157	2,380	15,295
1979	12,306	698	267	234	1,645	15,150
1978	11,780	618	251	258	1,466	14,373
1977	11,283	588	228	262	1,290	13,651
1976	11,024	577	217	266	1,247	13,331
1975	9,586	463	176	260	1,058	11,543
1974	10,754	470	231	295	1,583	13,333
1973	10,951	455	226	333	1,597	13,562
1972	10,470	389	223	298	1,887	13,269
1971	9,155	339	194	276	1,834	11,800
1970	9,043	343	175	295	1,683	11,541
1969	9,242	287	187	417	1,683	11,816
1968	8,535	261	175	409	1,381	10,761

1. Containerboard figure is mostly linerboard from 1968-78 and is entirely linerboard after 1978.
2. Boxboard figure is entirely folding carton stock.

Source: American Paper Institute.

clay-coated kraft board for folding carton and similar retail merchandise packaging has grown consistently in recent years, with minimal cyclicity. Industry production has risen 77.5% since 1975 to 821,000 tons in 1985, he said.

Clay-coated unbleached kraft board, in price and quality comparisons, is thought to be positioned between clay-coated recycled board and SBS used in milk cartons, cup/plate/food service items, and folding cartons. Coated unbleached kraft board is generally priced slightly higher than the recycled equivalent and somewhat lower than the SBS grade substitute.

Manville's list price for 20-pt clay-coated kraft folding carton grades, effective May 1, 1988, was $509/short ton. Mead's comparable 20-pt board was priced at $525/ton, effective March 1, 1988. This compares with SBS prices in the $625 to $660 range for 15-pt board and recycled prices from $440 to $460 for 20-pt stock.

SUS's higher values compared with SBS for tear, mullen or puncture, machine-direction stiffness, and machine-direction block compression translate into a 1-pt caliper drop against SBS in lower calipers and a 2-pt caliper reduction in the higher calipers, resulting in a 3% to 4% savings on top of 12% to 15% savings from lower prices. This adds up to a 15% to 19% total savings over SBS, according to Manville.

Manville claims it is able to produce SUS at a lower cost than SBS because the production process requires less in chemicals and labor. SUS is superior in strength because it is not bleached, a process that weakens fibers. Pearl-Kote has a bright blue appearance while SBS has a cream-white finish. In early 1988, Manville announced it would stop making TuffKote and produce only one premium clay-coated grade called Pearl-Kote.

Mead makes coated natural kraft on a 262-in.-wide fourdrinier at the Mahrt, Ala., mill, which was part of Georgia Kraft Co., an affiliate jointly owned with Temple-Inland Corp. until mid-1987 when a reorganization resulted in Mead's taking over full ownership of this facility. Until early 1987, the company also produced an additional 100,000 tpy at a nonintegrated coating facility in Atlanta, Ga., using board from Georgia Kraft or purchased from outside sources. However, that operation was shut down due to quality problems.

Mead's 1985 production was 426,000 tons or 51% of industry output, and it rose 3.3% to 440,000 tons in 1986. Mead converts 260,000 tons, or 59% of its output in its own domestic beverage carrier and folding carton facilities. The balance of output—180,000 tons, or 41%—is sold on the domestic market to other converters or to Mead's offshore affiliate producers.

Manville makes its SUS grades at its West Monroe, La., mill on paper machine Nos. 2, 6, and 7. In recent years major upgrades have improved quality and increased capacity at the mill, and the company planned another expenditure of $50 million in 1987 to raise mill capacity to 840,000 tons by year-end.

In mid-1985, Manville completed a rebuild of No. 7 paper machine, which makes its "third generation of solid unbleached sulfate," Pearl-Kote. This project reduced board plies to three from four and raised capacity to 575 tpd from 540 tpd. Arcu-Formas on the machine were removed and replaced with a third fourdrinier. No. 7 has a maximum speed of 1,500 fpm with a normal trim of 232 in. It has the largest yankee dryer in the world and coats the board in three stages, which gives a bright blue finish.

No. 7's output is converted to food cartons (for frozen pizzas, ice cream, candy, etc.) and boxes for various consumer products and hardware items (such as diapers and automobile shock absorbers). It is coated on one side (the printing side) and brown (unbleached) on the inside. Calipers range from 14 to 32 pt, and basis weights vary between 56 lb and 116 lb/1,000 ft². Some of the board is polyethylene-extruded on one or both sides by converters for wet or frozen end-use applications. It is marketed throughout the U.S.

No. 2 machine produces 175 tpd of lightweight (0.016 to 0.020 caliper) clay-coated board for both the beverage carrier and the folding carton markets, as well as a clay-coated preprinted linerboard. No. 6 makes 630 tpd of Aqua-Kote beverage carrier grade. The other two machines, Nos. 1 and 5, make semichemical corrugating medium and lightweight kraft paper for grocery bags and sacks, respectively.

In 1986, Manville raised the output of SUS on No. 2 machine by 100 tpd. At the same time, it began off-machine coating of SUS at its coater/laminator plant in West Monroe and was progressing with a $30-million, 300-tpd expansion and upgrade of No. 6 machine to bring total mill capacity of coated unbleached kraft board to 640,000 tons. In addition, engineering work was begun on a project to raise No. 7's capacity by 50 tpd and to spend a total of $50 million to boost overall mill capacity to 840,000 tpy by the end of 1987.

The latest quality improvement made by Manville for its SUS grades was in the second quarter of 1987, when it announced the development of a new clay-coating formula to improve surface smoothness and printability on its folding carton and carrier stock grades. At the same time, it mentioned a new grade called Aqua-Lite.

Mead, too, has been moving ahead with improvements and expansions. In its reorganization plan announced in March 1987, the company intended to assume complete ownership of the Mahrt mill and to build a new 350,000-tpy coated natural kraft board machine there.

With startup expected sometime in 1991, Mead's new mill was the major cause for an almost 30% jump in folding kraft linerboard capacity between 1989 and 1990. Mead plans to presell the new output by increased domestic conversion in its own plants, purchases from offshore suppliers to supply its offshore affiliates, and new opportunities in Japan resulting from an agreement with Seibu Saison.

The proposed new Mead mill was initially expected to produce linerboard. In the first full operating year, coated natural kraft output would be an estimated 50% or more of total production. Linerboard output would be less than 50% of production (in the range of 160,000 to 180,000 tons) and would be scaled back as clay-coated markets developed.

BLEACHED BOARD

GRADE STRUCTURE

Solid bleached sulfate (SBS) paperboard consists of at least 80% virgin bleached woodpulp. Although used primarily for folding boxboard and liquid packaging board, SBS is also used for cup/plate/tray stock and bleached linerboard. It is sometimes confused with bristols, which are also produced by some SBS mills (see chapter on bristols).

Bleached board comes in calipers ranging from 10 pt to 28 pt and in three levels of apparent density. Basis weights range from 120 to 300 lb/3,000 ft^2. Sheet density is the basis weight divided by caliper. It starts at 10.5 lb/pt (lb/pt of caliper on 3,000-ft^2 basis) or less for low-density board, such as high-quality folding carton, and it goes to 12.0 lb/pt or more for high-density board. Medium-density board is considered to be in the 10.5 to 12.0 lb/pt range.

Additives are mixed with the SBS stock furnish to give the sheet certain characteristics. In making folding carton, for example, a 5-lb/3,000-ft^2 coat weight—typically a clay coating using an S-B latex as binder—is usually added to the stock. Acrylic binders are also commonly used. In liquid packaging furnish, synthetic waxes are added to improve sheet holdout (liquid resistance) properties. About 50% of bleached boards are coated. Coating formulas vary according to the desired surface requirements and degree of holdout.

U.S. STATISTICS FOR BLEACHED BOARD

	1988e	1987	1986	1985
Production, 000 tons[1]	4,489	4,405	4,271	3,948
Capacity, 000 tons	4,768	4,675	4,576	4,370
Utilization rate, %	94.1	94.2	93.3	90.3
Exports, 000 tons	600	564	569	466
Imports, 000 tons	8	7	5	5
Apparent U.S. consumption				
000 tons	3,897	3,848	3,707	3,487
lb/capita	32.53	31.60	30.74	29.08
000 tons/$ billion real GNP (1972)	1.02	1.00	0.99	0.97

e = Estimate.
1. All tons are short tons.

Gloss calenders are used on machines making high-gloss board to improve the finish. On-machine coaters are used on most machines, but milk carton stock is extrusion-coated off the machine, normally at the paper mill.

A blend of softwoods and hardwoods in about equal proportions is used to make SBS board. The mix is varied depending on strength, density, and printability requirements. Softwood content is higher for liquid packaging, for instance, because of superior tear and tensile strength requirements.

Bleached board is generally made on a conventional fourdrinier, a flat-forming suction type, with a secondary headbox commonly included. Limited use is made of multi-fourdrinier paper machines, which combine a series of fourdrinier sections on a single machine.

The multi-fourdrinier machines produce a multi-ply board in which the top and bottom layers are made from bleached kraft (or sulfite) pulp and the middle plies are made from chemi-thermomechanical (or thermomechanical) pulp (CTMP or TMP). The stiffness of such multi-ply board may not be any greater than with SBS, but its cost is generally lower due to CTMP substitution. Another advantage of multi-fourdriniers is the capability of making thicker boards than possible on single fourdriniers.

Such multi-fourdrinier machines have been successfully operated by a number of Scandinavian companies. But the only North American producer to have made this type of board was Continental Forest Industries Inc. on No. 3 paper machine at the Augusta, Ga., mill. The Voith machine, which was installed in 1978, was designed to make a four-ply coated boxboard using TMP pulp for the two inner layers and bleached kraft for the two outside plies. But the mill experienced operating problems and was then sold in 1985 to Federal Paper Board Co. Inc., which converted it to production of 100% bleached kraft SBS paperboard.

Another attempt at using such technology in North America is being considered by Tembec Inc. The company is planning to install a 110,000-metric-tpy machine at its Temiscaming, Que., pulp mill, that would produce a low-density board using sulfite pulp for its outer plies and CTMP inside. The board, in the 8- to 14-caliper range, would be sold mainly to the bristol and graphics board markets. If financing can be arranged, the company hopes to begin the project in 1988 for startup in late 1989.

INDUSTRY STRUCTURE

Bleached paperboard is manufactured by about 14 major suppliers in the U.S. and by two in Canada. U.S. capacity is fairly concentrated, with the top five producers accounting for over 60% of capacity. International Paper Co., Federal Paper Board, and Westvaco Corp. are the three largest producers. As previously mentioned, Federal Paper Board significantly expanded its market share through the acquisition of Continental Forest's Augusta, Ga., mill. Jefferson Smurfit Corp. entered the bleached board segment in 1986 through its acquisition of Container Corp. of America's Brewton, Ala., mill. Mead Corp. stays in the segment, although in early 1987 Mead and Scott Paper Co. considered selling their joint-venture Brunswick Pulp & Paper Co.

Many bleached board machines are able to swing from making SBS board to bristols or market pulp in either rolls (usually fluff pulp) or bales. This allows producers to adjust production to market conditions and take advantage of more profitable markets. However, many mills prefer to remain consistent on their grade mix unless markets change substantially.

This swing capability makes it difficult to determine SBS capacity accurately, and it is thought that capacity is slightly higher than the reported 4.67 million tons in 1987. One estimate is that about 61% of bleached board capacity is dedicated to SBS board, 14% to bristols, 3% to pulp, and 22% to swing capacity.

Lower basis-weight and density requirements resulting from more sophisticated technology developed in the past decade have also impeded accurate assessment of bleached board capacity. A lower-density board with stiffness and quality comparable to higher-density board of several years ago is now possible. The result has been more units of product per ton of board. Another trend in the U.S. market has been toward upgrading the printing quality of folding carton board. Westvaco has been a leader with its "Printkote" stock.

Production/capacity trends. From 1970 to 1979, bleached board capacity grew at a 1.7% annual rate, but it

U.S. BLEACHED BOARD PRODUCTION BY END USES[1]

(000 short tons)

	Total	Cartons Folding	Cartons Milk	Heavy-weight cup stock	Plate, dish, and tray	Liner-board	Other food packaging	Misc. packaging[2]
1986	4,535	2,076	1,226	442	276	121	348	45
1985	4,282	1,955	1,227	422	245	(D)	404	29
1984	4,104	1,895	1,092	455	225	118	288	31
1983	3,988	1,901	1,060	440	252	113	191	31
1982	3,757	1,743	1,052	418	227	101	184	32
1981	4,070	1,981	1,085	427	245	120	223	49
1980	4,026	2,063	1,015	401	263	—	—	40
1979	3,883	1,999	1,090	341	232	102e	—	119
1978	4,002	1,934	1,048	400	277	159e	—	184
1977	3,882	1,822	1,040	419	296	92	53	160
1976	3,876	1,880	1,050	370	267	103	23	183
1975	3,420	1,540	1,052	329	274	88	—	137
1974	3,827	1,706	1,055	442	322	104	—	198
1972	3,741	1,637	1,006	389	350	139	—	220
1970	3,404	1,395	971	369	317	133	—	219

(D) = Data withheld to prevent disclosure of figures for individual companies.
e = Estimate.
1. Production for both foreign and domestic uses.
2. Includes other food packaging when not included in separate category 1970-1979.

Source: Bureau of the Census.

declined 1.9% during 1979-84, according to American Paper Institute figures. In 1985, however, capacity began to creep up again, rising from 4.37 million short tons to 4.67 million tons in 1986. Capacity is expected to grow moderately at about a 1.3% annual rate over the next three years, reaching 4.87 million tons in 1990.

The primary cause for the jump in capacity between 1985 and 1986 was the startup of a new 175,000-tpy SBS machine at Westvaco's Covington, Va., mill. However, some of this capacity was offset by the shutdown of a smaller, older machine at the same facility. API initially projected more substantial capacity gains in the late 1980s, but Federal Paper Board delayed expansion plans for its Augusta mill. At the same time, no other major projects were slated.

Many of the 25 bleached paperboard machines in the U.S. are located in the Southeast. Most range in size from 150,000 to 250,000 tpy, and more than half have been installed or rebuilt since 1970. Companies have tried to improve the efficiency of their mills in recent years through improvements in labor rules and capital spending projects. Several producers such as Potlatch Corp., International Paper, and Temple-Inland Inc. have undertaken major energy projects at their mills.

From 1976 to 1985, bleached board production rose at about a 1.5% annual rate. The weak performance reflected reduced domestic demand for milk cartons caused by inroads from plastic milk containers, competition from plastics in the food-service segment, and slower export growth. Another factor holding back SBS tonnage growth was a trend toward reduced basis weights, especially for folding cartons.

U.S. BLEACHED BOARD PRODUCTION

	Tonnage (000 short tons)	% change
Year-end		
1987	4,405	3.1%
1986	4,271	8.2
1985	3,948	–2.5
1984	4,048	3.2
1983	3,926	7.1
1982	3,665	–6.3
1981	3,910	1.2
1980	3,862	–3.4
1979	3,998	0.6
1978	3,972	6.9
1977	3,717	–3.1
1976	3,838	14.9
1975	3,341	–11.4
1974	3,769	–2.1
1973	3,852	3.9
1972	3,709	8.8
1971	3,408	1.1
1970	3,372	–5.3
1969	3,560	—

Source: American Paper Institute.

Total U.S. production of bleached board in 1986 was up 8.7% to 4.29 million tons after a drop of 2.5% to 3.95 million tons in 1985. In 1987, production again rose, moving up 3.2% to 4.4 million tons. The operating rates rose to 94.6% in 1986 and 94.2% in 1987 from 90.3% in 1985. Still, the rates for 1986 and 1987 were below the record 96.7% operating rate posted in 1984, when production reached 4.05 million tons. The 1985 downturn reflected a drop-off in export demand due to the strong dollar and low wastepaper prices, which enabled recycled boxboard producers to compete more effectively.

During the past decade, U.S. bleached board exports grew at about a 6% to 7%/year rate and accounted for about 12% to 14% of total U.S. production. From a peak of 557,000 tons in 1981, however, SBS production for export declined steadily to a low of 466,000 tons in 1985. The decline reflected the impact of the strong dollar and increased competition in Europe from Scandinavian producers, But as the dollar weakened, exports jumped 22% to 569,000 tons in 1986 and stayed flat at 564,000 tons in 1987.

Prices. The price of SBS has fluctuated, but it deteriorated primarily between 1981 and 1985—except for a brief recovery in 1984, when some producers were getting as much as $645 to $665/short ton for 15-pt folding carton

CAPACITY FOR BLEACHED BOARDS OF MAJOR U.S. COMPANIES

	Annual capacity (000 tons*)	Capacity share (%)
1. International Paper	848	18.1%
2. Federal Paper Board	631	17.6
3. Westvaco	600	14.3
4. Potlatch	537	11.7
5. Temple-Eastex	357	7.8
6. Champion International	247	5.4
7. James River	235	5.1
8. Weyerhaeuser	220	4.3
9. Gulf States Paper	210	4.1
10. Gilman Paper	185	4.0
11. Georgia-Pacific	171	3.7
12. Mead[1]	170	3.7
13. Container Corp. of America[2]	167	3.6
14. Union Camp	140	3.0

Total U.S. capacity (1988): 4.768 million short tons
Capacity share of top five companies: 62.4%
Capacity share of top ten companies: 85.0%

* Short tons.

[1] Reflects interest in Brunswick Pulp & Paper Co. which Mead plans to sell.

[2] Merged with Jefferson Smurfit Corp. in 1986 under an agreement with Morgan Stanley Leveraged Equity Fund creating a holding company called JSC/MS Holdings. Resulted in CCA becoming an affiliate of Jefferson Smurfit but retaining the CCA name.

stock. In 1981, the list price was a firm $625, which was eroded by discounting to a range of $500 to $590 in 1985, severely squeezing industry profitability. The decline in bleached board prices was probably aggravated by a dramatic decline in market pulp prices during this period. In 1986, though, the market began to strengthen and SBS prices rose to between $570 and $625. In 1987, prices increased to between $625 and $660. In 1988, producers announced a $40/ton price increase effective April 1.

MARKETS

Folding carton is the largest end use for SBS board, accounting for 50% of production in 1987. Milk carton stock made up about 25% of the market; cup and plate, 15%; linerboard and other packaging and nonpackaging stock (including printing boards, aseptic packaging, and ovenable paperboard), approximately 10%.

Competition in folding cartons. The folding carton market has been showing relatively slow growth, but SBS has maintained about a 38% market share. During the past ten years, total folding boxboard demand has been growing at a 1.3% average annual rate. During this period, SBS market share declined from about 38% in 1976 to about 35% in 1980, climbing back to 38% in 1987, according to API's production figures for domestic use.

Latest available statistics show total domestic folding boxboard production at 5.41 million tons, of which 2.4 million consisted of recycled boxboard (44.5%), 2.1 million of solid bleached sulfate (38.1%), and 940,000 of solid unbleached sulfate (17.4%). The fastest growth in the folding carton market has been achieved by the clay-coated unbleached kraft grades, which have nearly doubled their market share since 1972. Coated unbleached kraft grades not only offer greater strength than recycled boxboard and cost less than SBS, they will probably continue to increase their share of the market (see chapter on coated and uncoated kraft board).

Besides the growing popularity of coated kraft grades, the main reason for bleached board's fluctuating market share is a widening price gap with clay-coated recycled boxboard. The price differential between SBS and clay-coated recycled board, for example, widened to $230 in 1984 from about $130 in the late 1970s. Because of higher yield on an area basis due to lower density in bleached board, however, the difference between the two grades is less pronounced. Prices for coated unbleached kraft folding carton grades fall between the levels for SBS and recycled grades.

Prices for converted folding cartons have not kept pace with board prices in recent years, so several bleached board

U.S. CAPACITY FOR BLEACHED BOARDS

(000 short tons)

	Liner-board	Folding	Milk carton & food service	Other	Total	% change
1990e	146	2,543	1,998	180	4,866	0.2%
1989e	143	2,544	1,988	180	4,854	1.8
1988e	138	2,481	1,969	180	4,768	2.0
1987e	137	2,406	1,952	180	4,675	2.2
1986	135	2,341	1,926	175	4,576	4.7
1985	131	2,223	1,843	173	4,370	4.4
1984	119	2,095	1,771	200	4,185	2.1
1983	104	2,020	1,758	217	4,100	–3.0
1982	104	1,988	1,812	219	4,123	2.7
1981	108	1,904	1,774	229	4,015	–4.0
1980	116	1,954	1,865	246	4,180	–3.2
1979	133	2,080	1,916	189	4,318	2.9
1978	122	1,996	1,899	179	4,197	4.4
1977	97	1,930	1,824	170	4,020	0.6
1976	101	1,915	1,854	128	3,998	5.0
1975	95	1,751	1,859	102	3,807	–2.9
1974	108	1,851	1,848	113	3,920	–0.2
1973	141	1,749	1,899	139	3,928	3.7
1972	134	1,583	1,937	134	3,788	6.1
1971	143	1,455	1,842	128	3,569	2.8
1970	130	1,406	1,739	197	3,472	–2.4
1969	150	1,500	1,689	218	3,557	—

e = Estimate.

Source: American Paper Institute.

producers have sold their folding carton plants. Champion International Corp., Temple-Inland, and Potlatch have divested their folding carton plants in recent years.

Liquid packaging board demand has fluctuated during the past two decades. Production rose in the early 1970s but declined over the next 15 years. Domestic milk carton production fell almost steadily from 941,000 short tons in 1970 to 591,000 tons in 1982. In 1983, however, production was up 2.7% to 607,000 tons, and it rose 6.3% in 1984 to 645,000 tons. In 1985 and 1986, though, production fell to 609,000 tons and 591,000 tons respectively. In 1987, production rebounded again to 653,000 tons.

In 1985-86, liquid packaging board accounted for about 15% of the sanitary food container industry's sales, compared with 20% in 1972. About 505,000 tons or 17.5 billion units were shipped in 1985-86, according to the Dept. of Commerce.

Most of paperboard's loss of milk-packaging market share has been in the gallon and half-gallon sizes in the Midwest and West. Since 1980, erosion in the gallon segment has eased, but further loss in the half-gallon size is still a concern. Some forecasts call for plastic to capture as much as 50% of the market currently held by paperboard in the half-gallon segment.

According to the Dept. of Agriculture, total fluid milk packaging has shifted from paperboard's 78% share in 1971 to its 34.5% share in 1985. During that time, plastic containers (made from high-density polyethylene) went from 15% to 65.1%. Of the gallon containers for fluid milk sold in 1985 (the last year for which statistics are available), 98.4% were plastic and 1.6% were paperboard; in the half-gallon sizes, 16.7% were plastic and 81.5% were paperboard; in the smaller sizes, paperboard still had approximately 97% to 99% of the market.

U.S. BLEACHED BOARD EXPORTS[1]

(short tons)

	API[2]	Census
1987	564,000	—
1986	569,000	726,944
1985	466,000	666,605
1984	478,000	711,164
1983	514,000	734,430
1982	525,000	620,593
1981	557,000	767,412
1980	545,000	606,000
1979	466,000	508,000
1978	430,000	440,723
1977	389,000	374,823
1976	306,000	352,638
1975	—	284,203
1974	—	374,642
1973	—	265,169
1972	—	208,516
1971	—	183,257
1970	—	129,139
1969	—	131,946

1. Imports are minor.
2. American Paper Institute data represent production for export, not shipments.

Sources: American Paper Institute, Bureau of the Census.

In addition to competition from plastics, carton use has been depressed because of modest growth in domestic milk consumption. In 1985, 55.585 billion lb of milk were consumed in the U.S. While it was up 2.55% from the previous year, this figure was only a 2.2% improvement over 1975. From 1975 to 1983, domestic milk consumption steadily declined, but it has been growing since then. The USDA expected this trend to continue in 1986 and 1987. Projected were increases in domestic milk consumption of 1.0% in 1986 and between 0.5% and 1.0% in 1987.

Although carton use for milk packaging has declined, other liquid packaging has been growing. This is especially true for juice and juice derivatives. The Paperboard Packaging Council (PPC) estimates that juice and juice-drink cartons comprised 20% of the market in 1985 compared with about 5% ten years earlier. More cartons are being used to package other nondairy beverages as well as dry foods, pet foods, and various nonfood items, according to the U.S. Bureau of Industrial Economics.

The PPC has fought further deterioration in the paperboard carton market with a campaign started in 1982 to publicize the nutritional advantages of milk packaged in paperboard instead of plastic. The promotion appears to be working. In 1983-84, domestic milk carton consumption was up for the first time since 1975. It slipped again in 1985 to the same level as in 1983, but this was attributed by some industry experts to a temporary halt in the PPC campaign in 1985, when the promotion was challenged by the plastics industry. The promotion was resumed in 1986, however.

Other promotions begun in recent years could also have had some effect on increased milk carton sales. One is the introduction of the paperboard gallon two-pack as an alternative to the plastic gallon jug. Also, another milk carton promotion was begun in 1985 featuring photographs and descriptions of missing children on side panels of milk cartons; the promotion was later extended to paper cups. However, this campaign was losing popularity by early 1987.

The producers of milk cartons have highly integrated operations. Champion and International Paper are the largest producers of milk cartons, followed by Potlatch, Westvaco, and Weyerhaeuser Co.

Aseptic liquid packaging has been expanding rapidly in the U.S. since its introduction about five years ago. Estimates place the number of aseptic packages sold in the U.S. at about 3.5 to 4.5 billion units in 1986. However, the volume of liquid packaging board used for such aseptic packaging in the U.S. is still small, and most requirements are imported from Scandinavian producers. The preference for imports reflects the fact that the largest aseptic packaging converter in the U.S. is a subsidiary of a Swedish company. It is also true that Nordic mills have made considerable progress in manufacturing sophisticated multilayer liquid packaging boards. However, U.S. bleached board producers have been trying to become more important suppliers to this market, and one has established its own aseptic packaging operation.

Aseptic packages are made of specially treated paperboard combined with plastic film and aluminum foil or other combinations. Because of this, a solid bleached board does not necessarily have to be used for making such packages. The aseptic laminate is sterilized with a special hydrogen peroxide bath, high heat, steam, or other processes. After filling, the cartons require little or no refrigeration, they have greatly extended shelf lives, and they are compact and convenient to carry and store.

Aseptic containers are used to package soft drinks, juices and juice concentrates, gelled foods, baby foods, sauces, pastes, gravies, and puddings. Attempts have been made to market aseptically packaged milk in the U.S., but dairies have difficulty breaking consumer perceptions that milk must be refrigerated to remain fresh.

Aseptic packaging was developed in Europe and approved by the U.S. Food and Drug Administration in 1982. Most aseptic packaging comes from its inventor, AB Tetra Pak, a $2-billion Swedish company with an estimated 90% share of the world market. Its U.S. subsidiary based in Texas is Brik Pak Inc. Combibloc Inc., controlled by a Fed. Rep. Germany company, is the second largest manufacturer, followed by a relative newcomer, International Paper Co.

IP claims to have the most sophisticated extruder of its kind in the world at its Raleigh, N.C., operation. It can produce a 9-layered board with seven resin layers and one layer each of aluminum foil and paperboard. IP now sells its aseptic board in over 20 countries. The bleached paperboard is supplied from IP's mills at Moss Point, Miss.; Texarkana, Texas; and Pine Bluff, Ark.

IP entered the aseptic business in 1981 when it purchased the worldwide rights to market an Italian aseptic paperboard packaging system known as SA. In 1987, IP entered into a joint agreement with SIG Swiss Industrial Co. to market in North America the new SIG high-speed packaging system. In North America, IP claims to be the leader in what it terms "extended shelf life (ESL) packaging," and it is the only firm leasing and selling aseptic packaging machinery as well as producing the aseptic board.

U.S. PRICES FOR BLEACHED KRAFT BOARD

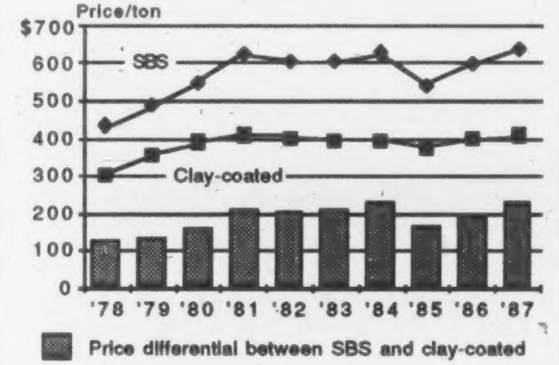
($/short ton)

	15-pt, folding carton, C1S 80 bright (rolls)	Cup stock, uncoated
1988		
3Q	$665/700	n.a.
2Q	665/700	n.a.
1Q	625/660	n.a.
1987		
4Q	625/660	$574
3Q	600/645*	n.a.
2Q	590/645*	n.a.
1Q	570/625*	n.a.
1986		
4Q	570/625*	556
3Q	570/625*	n.a.
2Q	550/600*	n.a.
1Q	(500/590)	n.a.
1985		
4Q	(500/590)	507
3Q	(500/590)	n.a.
2Q	550/665*	n.a.
1Q	550/655*	n.a.
Year-end		
1984	590/665*	584
1983	590/625*	565
1982	590/625*	507
1981	625	584
1980	550	565
1979	490	570
1978	425/445	581
1977	405	482
1976	385	457/468
1975	360/365	406
1974	360	386
1973	300	364
1972	265	342

Note: Prices generally higher on the West Coast.
n.a. = Not available.
( ) indicates estimated transaction prices where most volume is moving significantly below list.
* Discounting from list prices reported.

Source: *Pulp & Paper Week.*

FOLDING BOXBOARD PRICE TRENDS



Source: Pulp & Paper Pricebook 2

Forecasts of future aseptic packaging growth in this country are fairly euphoric. In a 1986 report, for example, Business Communications Co. (BCC) projected an annual growth rate of 10% for the aseptic food and beverage market over the next ten years. Total aseptic food/beverage containers were expected to reach 12.2 billion units, or about 4% of the food/beverage packaging market in 1995, compared with about 4.5 billion units, or 1.5% of the total 313 billion-unit market then current. Juices and juice products will remain the largest market segment through 1995, although they will show a slower rate of growth than other products packaged in aseptic.

Aseptic dairy products such as sour cream and individually packaged cream will gain wider acceptance over the next few years. But consumer preference for refrigerated milk will continue to thwart expansion of that product in aseptic packages, according to BCC.

The BCC study notes that viscous and particulate products will be the most attractive new additions to the aseptic food/beverage line. The first real challenge to metal and glass packaging will occur during the late 1980s and early 1990s with the introduction of aseptic processing equipment and fillers that can preserve particle integrity, such as for soup.

The performance of **ovenable paperboard**, another food service item, has failed to match industry expectations. This type of paperboard, which can be used in both microwave and conventional ovens, has undergone considerable technological improvements in structure and design since it was introduced in the 1970s. Ovenable paperboard is typically made by coating SBS with a polyethylene terephthalate resin and pressing it into trays.

While the use of microwave ovens has grown dramatically, the current size of the ovenable paperboard

U.S. SANITARY FOOD CONTAINERS INDUSTRY: VALUE OF SHIPMENTS AND CONSUMPTION OF PAPER AND BOARD

	1977*		1982**	
	Paper & board consumed (000 sh ton)	Value of products ($ million)	Paper & board consumed (000 sh ton)	Value of products ($ million)
Total: (SIC Code 2654)	—[1]	1,951.7	—[1]	2,545.6
Milk and milk-type cartons[2]	751	479.0	569	550.0
Cups and liquid-tight containers	—	606.0	—	885.0
Liquid-tight containers[3]	35	41.0	32	64.0
Drinking cups[4]	600	565.0	451	821.0
Cups[5]	—	—	—	0.1
Other sanitary food containers[6]	—	831.0	—	356.0
Food serving products				
Stamped plates, dishes, spoons, etc.	216	173.0	227	259.0
Other paperboard items	73	43.0	32	63.0
Other paper items[7]	21	16.0	—	—
Folding containers for liquid[8]	—	—	—	712.0
Frozen foods and bakery[9]	428	341.0	196	229.0
Butter and ice cream packaging and food pails	183	138.0	155	170.0
Processed meats, margarine[10]	73	70.0	83	106.0
Others[11]	—	56.0	—	42.0

1. Data not collected or available.
2. Including juices, beverages, and other products.
3. Plus round nested food containers, including lids and tops.
4. Plus portion serving cups.
5. And liquid-tight containers not classified.
6. Includes food containers, boards, and trays.
7. Includes tablecloths and soda straws, except glass or plastic.
8. Containers for liquid, moist, oily, or perishable foods, including frozen foods.
9. Including frozen bakery.
10. Plus lard and shortening.
11. For fresh meat, poultry, and produce for retail packaging.

* Source: 1977 Census of Manufactures.
** Source: 1982 Census of Manufactures.

market in the U.S. may still be less than 30,000 tpy, according to some estimates. One reason is the development of an all-plastic tray that has been widely accepted by the frozen-food industry. Nevertheless, demand for ovenable paperboard has continued to grow at about a 6%/year rate over the past several years, according to the Dept. of Commerce. The increasing popularity of oven-ready meals and single-portion servings should continue to provide some growth for paperboard in this market. Westvaco, International Paper, Federal Paper Board, and Champion International are among ovenable board and tray producers.

Plastics in food service. As in liquid packaging, bleached board has been facing heavy competition from plastics in the food-service segment. While dollar sales of converted trays, plates, cups, and nested and liquid-tight containers have remained fairly stable, unit volume of such paper products has probably been declining, according to the Dept. of Commerce. In an attempt to counter the competition from plastics, the industry has concentrated on improving the strength, appearance, and design of its cups and other food-service products.

According to API statistics, bleached board production of heavyweight cups and rounded nested food containers has been relatively flat over the last decade. Output in 1987 totaled 446,000 tons, which is only an 8% improvement on the 412,000 tons produced a decade earlier in 1976.

Plastics has captured about 60% of the beverage cup market, according to some industry estimates. Weak plastic resin prices in 1985-86 helped some integrated resin producers such as Mobil Corp. and Amoco Corp. gain market share. The recent strengthening in plastic resin prices that began in 1987 has reduced their price advantage, but plastic food-service products still cost less than the paper equivalent. Polyethylene-coated board has been able to hold its market share best in the larger-size cold-service cups, while plastic foam cups have made their largest inroads in the hot-service area.

Significant plastic inroads have also occurred in nested and other liquid-tight containers. Thermoformed plastic containers, for example, have taken over much of the market for dairy products such as cottage cheese and yogurt.

Bleached board production for plate, dish, and tray stock has also been flat. Production in 1987 was placed at 280,000 tons and has generally fluctuated close to that level throughout the past decade. Plastic plates have captured most of the retail and consumer market from both pressed bleached board and molded pulp plates. James River Corp. is a major integrated producer of both paper and plastic food-service products with its Marathon and Dixie lines, and Fort Howard Corp. is a major nonintegrated converter with its Maryland Cup subsidiary.

OUTLOOK

Analysts expect the bleached board market to expand slightly in 1988. According to one estimate, folding carton production will reach about 2.075 million tons in 1988, with milk carton increasing to 665,000 tons, cup stock rising to 475,000 tons, and plate stock increasing to 310,000 tons.

Total SBS production is expected to reach 4.50 million tons in 1988, according to one analyst. Another projects a hike to 4.623 million tons in 1988 and 4.642 million tons in 1989.

The long-term forecast for folding carton stock remains optimistic because of increasing demand for packaging and improved graphic displays. Food companies, for instance, are using new packaging to both introduce new products and promote existing mature products. In addition, the increase in microwave oven sales has expanded the market for microwave foods, which are packaged mostly in folding cartons. A greater emphasis on health foods has opened up new packaging opportunities at the same time drug companies are increasing the number of over-the-counter products to meet the growing interest in remaining healthy.

Provided that consumers continued spending more of their income on packaged foods and disposable food-service products, the Dept. of Commerce expected the real value of sanitary food container shipments to climb about 2% in 1987, about the same rate of growth as in 1986. Sales of paperboard milk cartons were expected to increase slightly during 1987 at the expense of plastic containers, the result

FLUID MILK SALES BY PACKAGE SIZE & TYPE*

Container size	Total sales (million lb)	Type of Container (% of total sales) Glass	Paper	Plastic
Gallon	2,158.2	<0.1%	1.6%	98.4%
Half-gallon	801.1	1.8	81.5	16.7
Quart	174.2	1.4	97.2	1.4
Pint	58.8	<0.1	98.8	1.2
Half-pint	327.8	<0.1	99.4	0.6

* Sales for Nov. 1985 by handlers regulated in Federal Milk Order markets. Represents 75% of U.S. handlers.

Source: U.S. Dept. of Agriculture.

PERCENT OF FLUID MILK SALES* BY PACKAGE TYPE

Year	Glass	Paper	Plastic	Other
1985	<0.5%	35%	65%	<0.5%
1983	<0.5	38	62	<0.5
1977	1.0	58	41	<0.5
1971	7.0	78	15	<0.5
1966	25.0	67	6	2.0
1963	32.0	63	n.a.	5.0

n.a. = Not available.
* Represents total fluid milk, including whole, lowfat, and skim.

Source: U.S. Dept. of Agriculture.

of expansion into new markets. Sales of aseptically packaged juices and other drinks were expected to continue to expand; however, aseptic milk shipments should grow more slowly, constrained by hard-to-change consumer buying habits and tastes, according to the Dept. of Commerce.

For the 1987-91 period, the Dept. of Commerce's forecast calls for an average annual growth rate of about 2.2% for sanitary food container shipments, provided there is gradual improvement in retail food sales as well as continued growth in fast foods and convenience foods.

Aseptic and microwave containers will continue as the packaging industry's growth leaders. New food-packaging mediums will appear, especially barrier plastics (coextruded, multilayer, plastic containers that extend nonrefrigerated shelf life for a variety of food products such as juices and sauces) and retortable, flexible, food-filled plastic bags, which also extend nonrefrigerated shelf life and are especially geared to packaging solid foods.

Plastics will play an increasing role in the construction of the aseptic package, sometimes displacing paperboard and foil completely. Sales of ovenable paperboard trays will continue to rise, but plastics will likely provide increasing competition in this packaging sector.

Export shipments of U.S. bleached board should continue to grow faster than domestic demand. However, the growing use of aseptic packaging in various parts of the world may favor Scandinavian producers, particularly in Europe. Most future growth for U.S. exports will be in Asia, which now accounts for about 70% of U.S. milk carton shipments.

CONVERTED BLEACHED BOARD PRICES

(BLS price index)

	Milk and milk-type containers[1]	Cups and liquid-tight containers[2]	Bleached packaging and industrial converting paperboard[3]
1987			
4Q	334.7	109.3	106.9
3Q	336.8	109.3	106.8
2Q	337.5	106.7	107.3
1Q	332.9	105.2	108.7
1986			
4Q	334.3	105.0	108.3
3Q	33[illegible].6	102.0	107.3
2Q	332.7	100.6	106.2
1Q	333.3	100.1	105.9
1985			
4Q	335.9	100.2	107.7
3Q	339.5	99.9	107.9
2Q	336.2	n.a.	108.2
1Q	329.1	n.a.	108.5
Year-end			
1984	314.0	231.0	109.3
1983	302.5	220.0	103.0
1982	275.8	220.0	—
1981	257.5	220.0	—
1980	220.8	197.1	—
1979	199.0	180.1	—
1978	185.0	148.1	—
1977	180.7	140.2	—
1976	169.3	132.6	—
1975	157.7	126.7	—
1974	145.0	125.6	—
1973	109.3	106.4	—
1972	106.7	103.3	—
1971	102.0	103.3	—
1970	99.8	98.8	—

n.a. = Not available.

[1] 1967 = 100 (per 1,000). Listed as "Milk Cartons, Gal." prior to July 1985.

[2] June 1985 = 100; 1967 to June 1985 = 100 (per 1,000). Listed as "Paper cups, hot" prior to June 1985.

[3] December 1982 = 100.

Sources: U.S. Dept. of Labor, Bureau of Labor Statistics, Producer Prices and Price Indexes.

SUMMARY OF SANITARY FOOD CONTAINER INDUSTRY STATISTICS (SIC Code 2654)

	Plants (total)	Employees	Value of shipments[1] ($ million)	Capital expenditures ($ million)
1987e	—	22,800	$2,733	—
1986	—	22,600	2,706	—
1985	—	22,400	2,679	—
1984	—	22,800	2,762	$64.6
1983	—	23,600	2,912	78.5
1982	145	24,600	2,826	67.1
1981	—	28,300	2,842	70.7
1980	—	28,400	2,900	56.0
1979	—	29,800	3,196	65.7
1978	—	28,900	3,161	71.5
1977	193	28,700	3,258	52.4
1976	—	30,600	3,330	53.8
1975	—	28,300	3,151	29.6
1974	—	—	3,365	44.5
1973	—	—	3,424	38.0
1972	251	35,100	3,461	42.3
1971	—	—	—	33.8
1970	—	—	—	39.8

e = Estimate.

[1] Value of industry shipments, not products, in 1982 dollars.

Source: Census of Manufactures.

RECYCLED PAPERBOARD

GRADE STRUCTURE

Recycled paperboard typically consists of 100% secondary fiber and is produced on either a multiformer or fourdrinier paper machine. Recycled mills tend to be older, slower, and less efficient than those found in other sectors of the industry. Average size of recycled paperboard machines in the U.S. is about 140 tpd compared with about 490 tpd for solid bleached and 750 tpd for unbleached kraft board. However, recycled mills are usually closer to their customers, reducing shipping and wastepaper costs and enabling them to provide quick response to customer needs.

Recycled paperboard includes a diverse collection of grades, including boxboard, containerboard, and various types of paperboard. Capacity in 1988 breaks down as follows: folding boxboard, 28.5%; setup boxboard, 2.9%; corrugating medium, 18.6%; gypsum linerboard, 14.8%; linerboard, 6.2%; container chip and filler board, 0.5%; other paperboard, 28.5%. "Other paperboard" includes nonpackaging and miscellaneous end uses such as tube, can, drum, tag, file folder, match stem, tablet backs, and toys. Not included are various types of construction paper and board (except for gypsum wallboard liner).

Boxboard grades usually consist of four or more plies. The top layer is made from deinked pulp or other high-quality wastepaper such as one of the pulp substitutes. Middle plies are made with lower-quality paper stock, such as old news and mixed papers combined with some old corrugated containers for added strength. The fiber content of the bottom layer (or back ply) depends on the strength and appearance sought in the finished product, and fiber choices include news, corrugated, and pulp substitutes.

GENERAL OUTLOOK

Overall demand for recycled paperboard grades has been showing slow growth due to competition from virgin grades, plastic packaging, and declining end-use markets. Production over the past 15 years has grown at an average rate of only 0.6%/year. The fastest growth has been in clay-coated boxboard grades, containerboard, and gypsum linerboard, and these trends are expected to continue. At the same time, uncoated boxboard, setup boxboard, and some miscellaneous uses have been declining.

The combination of slow growth in many markets and rising energy and fiber costs has caused a number of mills to shut down since the 1970s. In addition, the industry has undergone a major period of consolidation. More capacity has been retired from recycled paperboard than from any other sector of the industry, with more than 2.7 million short tpy, or 34% of recycled paperboard capacity, taken out of production in the 1970s. Machine rebuilds offset the losses, however, keeping capacity relatively stable.

U.S. STATISTICS FOR RECYCLED BOXBOARD AND PAPERBOARD

	1988e	1987	1986
Production[1], 000 tons[2]	8,900	8,594	8,083
Capacity, 000 tons	9,446	9,252	9,008
Utilization rate, %	94.2	92.9	89.7
Imports, 000 tons	143	151	95
Export, 000 tons	67	60	70
Apparent U.S. consumption			
000 tons	8,976	8,685	8,108
lb/capita	71.3	69.6	65.6
000 tons/$ billion real GNP (1972)	2.26	2.24	2.16

e = Estimate.

1. American Paper Institute data.

2. All tons are short tons.

Between 1977 and 1986, recycled board capacity increased just 176,000 tons for an average annual growth of 0.2%, according to the American Paper Institute. Much of this additional capacity resulted from the startup of Inland Container Corp.'s new 175,000-tpy Ontario, Calif., recycled linerboard mill in 1985.

Despite the removal of 100,000 tons of annual capacity in 1986 due to an idled mill, capacity for recycled paperboard between 1985 and 1987 rose by 457,000 tons, a 5.2% increase. Future capacity additions are expected to add another 277,000 tons—mainly in corrugating medium, linerboard, and folding carton—between 1987 and 1990. A good portion of this involves the conversion of two paper machines to recycled containerboard, as well as more than 20 separate machine rebuilds and capacity expansions across the U.S.

INDUSTRY STRUCTURE

A number of companies such as Jefferson Smurfit Corp., Newark Group Inc., Sonoco Products Co., Caraustar Industries Inc., and Rock-Tenn Co. have been expanding their positions in the industry, while others have been selling off or closing their recycled board mills. With 1.2 million tpy of capacity, Jefferson Smurfit has become by far the largest player in the industry through its 1986 acquisition of 50% of Container Corp. of America and its earlier acquisitions of Alton Packaging Corp. and Diamond International Corp.'s two boxboard mills. In 1986, the company also acquired Union Camp Corp.'s Monroe, Mich., recycled board mill.

Sonoco Products Co. has become the second largest recycled paperboard producer with an estimated 750,000 tpy of capacity. In 1987, the company bought Boise Cascade Corp.'s Consumer Packaging Div., making it the country's largest producer of composite cans, tubes and cores. In 1988, the company purchased Federal Paper Board Co.'s Richmond, Va., recycled board mill.

Similar consolidation has occurred recently in Canada, where Paperboard Industries Corp. of Toronto acquired Belkin Inc. of Vancouver, B.C. The combined company has become by far the largest recycled paperboard producer north of the U.S. border, with an estimated 550,000 tpy of boxboard and containerboard produced at six mills.

In 1987, the trend to sell and consolidate recycled board output continued as Mead Corp. and Packaging Corp. of America both put their recycled board mills up for sale. PCA reached a tentative agreement to sell its recycled business to Republic Gypsum Co., but the deal later fell through and no other buyers surfaced. Mead, however, successfully completed the sale of its recycled division to Rock-Tenn.

One of the largest reductions in U.S. recycled board capacity occurred in 1980 when Whippany Paper Board Co. declared bankruptcy and idled 450,000 tpy. Some of the former Whippany mills have been sold but not reopened permanently. One company briefly operated the former Durham mill in Riegelsville, Pa., then sold it in 1985 to International Paper Co., which was still considering plans to reactivate it in early 1988. Likewise, the Clifton, N.J., mill of Whippany was to be sold in 1985 to V. Ponte & Sons, a wastepaper dealer, but the deal fell through. However, in late 1987 the sale was finally closed but no startup date was set.

As a result of such activities, industry concentration has increased significantly over the past decade, and the share of total U.S. recycled board market held by the ten largest producers has grown from 42% in 1978 to 57% in 1988.

Another interesting development has been foreign investment in the U.S. recycled paperboard industry. In late 1986, Settsu Corp., the largest Japanese recycled paperboard producer, acquired approximately a 22% interest in Caraustar Industries, which has 480,000 tpy of capacity at nine mills in the southern and eastern U.S. The agreement is expected to involve some cooperation in marketing and possibly an exchange of technology.

RECYCLED COMBINATION PAPERBOARD, BOXBOARD, AND PACKAGING GRADES

- Album board
- Automobile board
- Bending chipboard
- Blister board
- Can stock
- Car lining board
- Chipboard
- Cracker shell board
- Core stock
- Corrugating medium
- Drum stock
- Florist board
- Innersole
- Jute board
- Kraft-backed board
- Laminating board
- Lined board
- Manila board
- Matchbook board
- Mat-finishing board
- Moistureproof board
- Mounting board
- Newsboard
- Offset blanks
- Patent-coated
- Pasteboard
- Photo-mount board
- Poster board
- Pulpboard
- Saturating board
- Shoeboard
- Test chipboard
- Test linerboard
- Transformer board
- Tube stock
- Wallboard
- Water-resistant board
- Waterproof board
- Wet-strength board
- White-lined board

TYPICAL GRADE STRUCTURE FOR TEST LINERBOARD

Basis weight[1] (lb/1,000 ft^2)	Caliper[1] (0.001-in.)	Mullen[1] (psi)
42	12	80-85
47	13	90
48/52	13/15	95/100
69	19	130

1. Tests are approximate. These grades supplied in other weights and at different levels of mullen.

Even more unusual was China National Packaging Corp.'s purchase of Morris Paper Board Co.'s 110-tpd mill at Morristown, N.J., in early 1986. The Chinese said their initial plan was to run the mill in the U.S. and study its operation. Its ultimate fate, however, could be like that of the former 250-tpd Nabisco Inc. boxboard mill in Marseilles, Ill., which was acquired by Federal Paper Board. The equipment was then scrapped and sold to a Hong Kong firm in 1987.

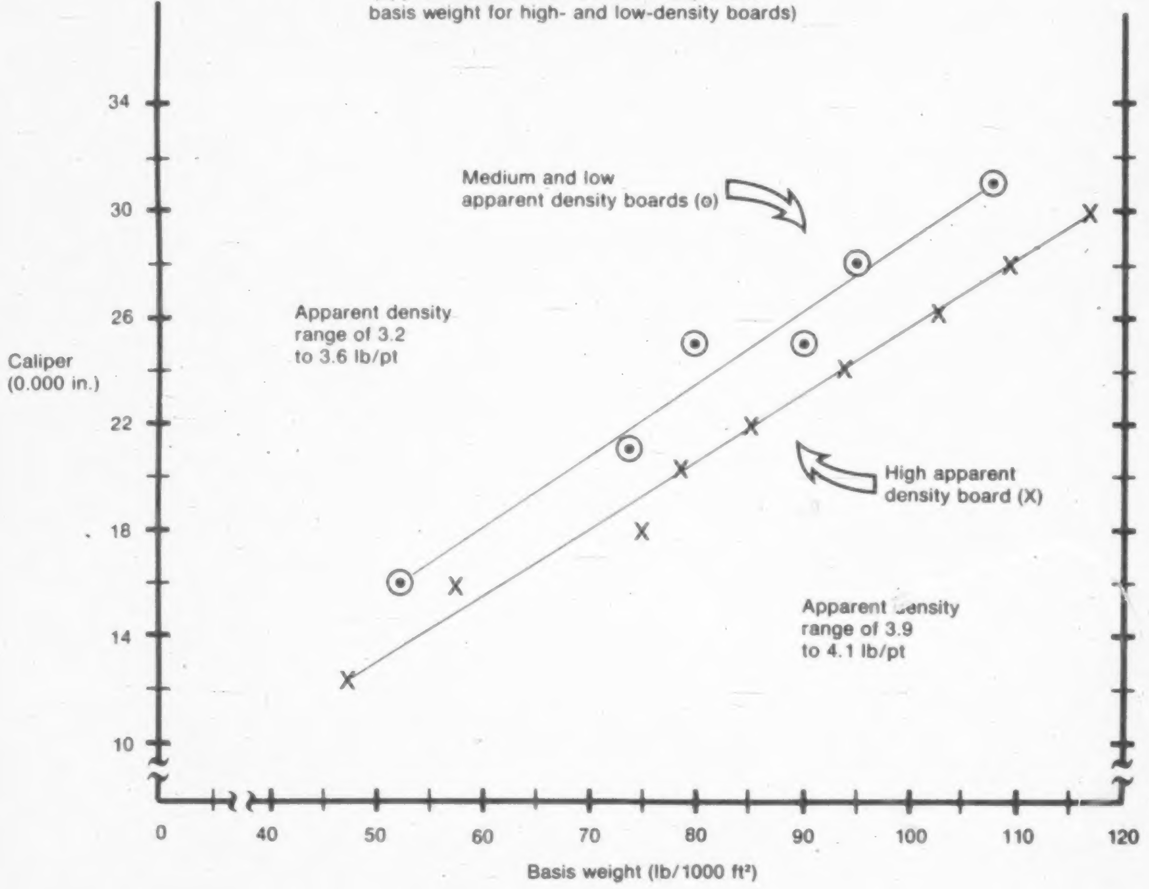
The competitiveness of recycled paperboard mills continues to be affected by high energy costs (since these mills rely on purchased energy and have no spent pulping liquors or woodwastes to burn) and fluctuations in wastepaper costs. In 1986 and 1987, when secondary fiber prices skyrocketed yet recycled board markets were not tight enough for prices to be raised proportionately, mills' profits were substantially depressed. Conversely, when wastepaper prices are down, recycled mills have an edge over virgin grades.

Operating rates in recycled paperboard mills have improved in recent years, rising from 86.8% in 1985 to 92.9% in 1987, when production rose from the year before by 6.3% to 8.594 million tons.

RECYCLED FOLDING BOXBOARD

Clay-coated grades have a dominant share of the folding carton market. Other recycled folding boxboard grades, such as uncoated bending chipboard and white and kraft-lined grades, account for a much smaller amount of total folding boxboard output and were in a long-term decline until 1987. The remainder of the folding carton market consists of solid bleached sulfate (SBS) and clay-coated unbleached kraft grades made mainly from virgin fiber. As a result of competition from virgin grades, production of recycled boxboard for folding cartons has remained relatively flat at around 2.3 million tons, according to API statistics.

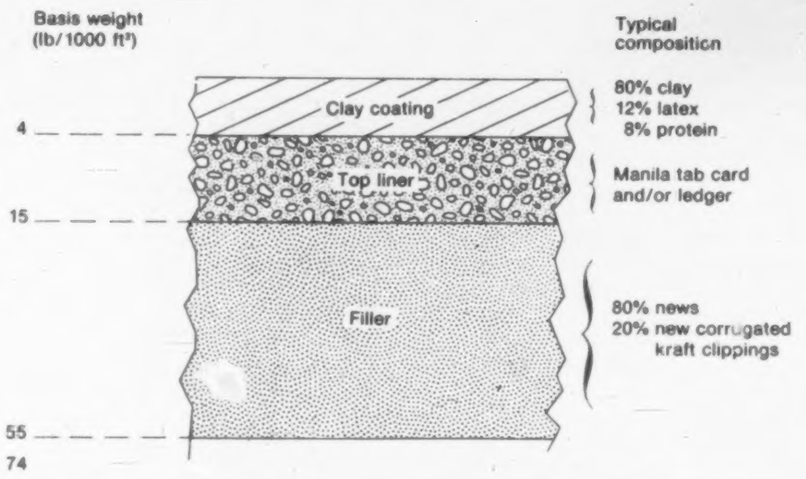
API reported that recycled paperboard's share of the



TYPICAL GRADE STRUCTURE FOR BOXBOARD GRADES

(approximate relation between caliper and basis weight for high- and low-density boards)

COMPOSITION OF 18-POINT CLAY-COATED FOLDING BOXBOARD


Basis weight
(lb/1000 ft²)
Typical
composition
Clay coating
80% clay
12% latex
8% protein
4
Top liner
Manila tab card
and/or ledger
15
Filler
80% news
20% new corrugated
kraft clippings
55
74

U.S. PRODUCTION OF BOXBOARD GRADES—FOLDING AND SETUP

(000 short tons)

	Total folding	Recycled folding boxboard[1] Unlined chipboard	Kraft lined	White lined	Clay coated	Total setup boxboard[2]
1986	2,284	441	219	168	1,456	273
1985	2,268	468	203	193	1,404	259
1984	2,310	471	168	224	1,447	307
1983	2,369	585	180	227	1,377	263
1982	2,152	546	146	152	1,308	238
1981	2,425	—[3]	176	189	—[3]	298
1980	2,350	606	81	220	1,443	560
1979	2,386	678	98	229	1,380	604
1978	2,469	706	131	247	1,384	687
1977	2,423	687	133	274	1,330	717
1976	2,508	707	145	313	1,343	747
1975	2,108	564	124	274	1,146	672
1974	2,423	697	137	439	1,149	796
1973	2,652	740	146	520	1,246	998
1972	2,656	793	140	533	1,190	985
1971	2,575	—[3]	—[3]	—[3]	—[3]	979
1970	2,727	—	—	—	—	1,042
1969	2,852	—	—	—	—	1,164

1. Bureau of the Census defines as combination bending board.
2. Bureau of the Census defines as combination nonbending board. These boards are used to produce rigid paperboxes, among other uses.
3. Data not available.

Source: Bureau of the Census.

folding carton market dropped from 49.6% to 44.5% between 1976 and 1987. At the same time, unbleached kraft's share rose from 12.2% to 17.4%, while SBS's share remained relatively flat at 38.1%.

According to the Dept. of Commerce, however, in 1986 about 52% of folding cartons was made from nonrecycled board, up from 51% in 1985. This growth occurred despite a significant rise in dry-food packaging, which uses mostly recycled board. Use of SBS, which comprises approximately 35% of total industry consumption, remained weak in 1986, but greater utilization of unbleached kraft grades more than compensated for the loss.

At the same time, use of clay-coated recycled board declined to about 38% in 1986, while consumption of the cheaper, darker grades increased. Shifts in the mix of boxboard consumption during the past few years have largely been determined by fluctuating costs of that material, by various environmental and political pressures to recover and recycle wastepaper, by existing supplies, and by changing demand patterns within the end-user markets—especially food and beverages.

Clay-coated recycled boxboard, which is coated one side only on an on-machine coater, is used for nonfood products such as soaps and detergents, hardware, toys, and lower-priced cosmetics. It also has applications where food is first packaged in a bag or other container, such as dry cereals. In addition to clay coating, waxes, polyethylene, and other special coatings may be applied to give the package special properties. Clay-coated news is readily identifiable by the gray appearance of its unprinted side.

Quality and productivity have been upgraded in a number of folding boxboard mills by replacing inefficient cylinder board machines with multi-ply formers. Formers such as the Ultra Former have enabled mills to compete more effectively with coated solid bleached board—the major competitor to clay-coated. A lower-density sheet can be produced on these formers more effectively than on conventional cylinder machines—3.9 to 4.2 lb/pt vs 3.4 to 3.8 lb/pt with newer formers.

During the recession of 1981-82, coated recycled boxboard grades appeared to compete better against solid bleached board (see Bleached Board chapter). More recent statistics, however, indicate that virgin board continues to lead recycled by a small amount. According to industry figures, virgin board accounted for 50.9% in 1985 and recycled board 49.1%. This compares with 50.7% and 49.3%, respectively, in 1975.

The most notable change in this market mix has been in the grade categories themselves. In recycled board, clay-coated grades have grown to 37.3% from 31.8%. In the virgin board categories, kraft board has advanced to 14.2% from 12.3%, while SBS declined to 36.7% from 38.4%.

According to Leonard S. Smith of the Office of Forest Products and Domestic Construction of the Bureau of Industrial Economics, Dept. of Commerce, the value of folding carton shipments (measured in 1982 dollars) was forecast to increase in 1987 by about 2% and to total about three million short tons. This is slightly below the 2.4%

U.S. PRODUCTION OF SPECIAL RECYCLED PACKAGING AND INDUSTRIAL CONVERTING PAPERBOARDS

(000 short tons)

	Total	Gypsum linerboard	Tube, can, and drum stock	Panelboard wallboard stock	Others
1986	2,950	1,145	1,043	64	698
1985	2,814	1,079	1,021	68	646
1984	2,772	915	1,064	150	643
1983	2,406	798	858	148	602
1982	2,119	750	767	119	635
1981	2,144	809	634	100	601
1980	2,262	1,036	564	113	548
1979	2,543	1,210	628	137	568
1978	2,453	1,185	601	119	546
1977	2,378	1,099	680	113	485
1976	2,205	963	701	86	454
1975	1,913	821	630	67	395
1974	2,228	960	733	67	467
1973	2,403	1,051	763	94	493
1972	2,278	1,053	728	117	380
1971	2,048	936	641	105	366
1970	1,739	807	573	90	270
1969	1,771	847	527	113	285

Source: Bureau of the Census.

rate of growth forecast for the entire paperboard sector, since folding carton growth depends less on consumer spending patterns than do other grades. The 1987-91 outlook calls for a 1.5% annual growth rate.

RECYCLED SETUP BOXBOARD

Preformed boxes are the primary use for setup boxboard, also called nonbending paperboard or boxboard. Grades include plain chipboard, news vatlined chip, filled news, and white vatlined chip. These grades can be pasted or laminated to form nonbending boards of greater thickness. Setup paperboard is overwrapped with specialty grades of paper for a more attractive box. Candy, stationery, and textiles are among the most common uses for setup boxes.

Setup paperboard is usually made from wastepaper of a lower grade than that used for folding cartons because bending and scoring requirements are lower for setup boxes. Basis weights and calipers of this grade range from as low as 15-pt (0.015-in.) to 65-pt (0.065-in.) board. A 15-pt board has a basis weight of 60 lb/1,000 ft^2 (293 g/m^2).

Setup paperboard production has decreased sharply over the last decade to 233,400 tons in 1986 from about 519,000 tons in 1968. The declining demand for setup boxes has caused a significant amount of consolidation among setup-box converters.

The Dept. of Commerce's Smith, however, thinks the rigid-box industry's turnaround began in the early 1980s and will continue through 1991. During 1983, the value of shipments on a constant dollar basis increased slightly after six consecutive years of declining real growth (1976-82), mainly due to U.S. economic growth trends and changing consumer disposable income and spending levels.

The industry, however, is trying to move ahead. It has made strides in cutting costs and boosting productivity, diversifying its product mix, and opening new market areas. Converters have improved product design and appearance, graphics, and color printing through the use of better inks and ink-curing processes, as well as new processing and coating techniques that improve strength and moisture resistance of rigid boxes.

Such moves should help setup boxes carve out a bigger niche in the market for special purpose, higher-value, luxury packaging. The Dept. of Commerce forecasted about a 2% rise in the real value of setup paperboard box shipments in 1987 and a 1.5% increase annually during 1987-91. Cosmetics, pharmaceuticals, confectionery, and electronics were expected to be future growth areas for packaging. Competition from other packaging, especially plastic containers, was expected to continue, but setup board should retain much of its market share for specialty packaging.

U.S. PRODUCTION OF RECYCLED SHIPPING CONTAINERBOARD GRADES

(000 short tons)

	Total	Linerboard	Corrugating medium	Chip and filler boards
1986	2,495	761	1,568	167
1985	2,560	918	1,486	157
1984	2,407	846	1,397	164
1983	2,565	879	1,519	167
1982	2,097	504	1,427	165
1981	1,750	250	1,315	185
1980	2,070	518	1,281	271
1979	2,050	460	1,301	290
1978	1,981	332	1,408	242
1977	1,908	379	1,286	243
1976	1,470	227	1,040	202
1975	1,129	196	788	145
1974	1,766	454	1,114	198
1973	1,741	295	1,204	241
1972	1,476	279	942	255
1971	1,390	263	879	248
1970	1,522	321	916	285
1969	1,624	402	939	283

Source: Bureau of the Census.

CANADIAN PRODUCTION OF BOXBOARD GRADES

(000 metric tons)

	Folding	Nonfolding	Other*	Total
1986e	355	103	320	778
1985	349	101	301	751
1984	329	129	299	757
1983	322	116	268	704
1982	277	104	245	627
1981	300	118	298	716
1980	281	107	292	680
1979	286	108	338	731
1978	247	121	321	689
1977	216	121	280	617
1976	203	73	247	525
1975	174	92	216	482
1974	231	129	288	647
1973	242	96	274	612
1972	248	86	271	605
1971	238	91	240	569
1970	234	93	243	570
1969	239	95	248	582

e = Estimate.

* Includes solid bleached board, liner for gypsum or plaster board, and mill wrapping.

Source: Canadian Pulp & Paper Assn.

CONTAINERBOARD

Recycled paperboard grades—linerboard and corrugating medium—are made on fourdrinier or cylinder board machines. Recycled linerboard, also known as test linerboard, is normally made using old corrugated containers in the fiber furnish. It is made to a given burst or mullen—for example, 95 to 100 psi to be equivalent to 42-lb linerboard from virgin kraft fiber.

To make an equivalent test level to virgin linerboard, a mill will normally produce a higher sheet weight. For example, a 100-lb test recycled linerboard might have a basis weight of 48 to 50 lb/1,000 ft², compared with 42 lb for virgin linerboard.

U.S. production of test linerboard has remained relatively flat for years at around 300,000 to 400,000 tpy, with sharp cyclical fluctuations. Demand is strongest when the virgin linerboard market is tight, but it can fall off sharply in a recession. Production of recycled linerboard, however, is expected to increase in the U.S., due to limited supply of kraft linerboard and the low capital cost of installing new recycled capacity. In the last couple of years, capacity to produce recycled linerboard has jumped to about 600,000 tpy with the startup of Inland Container Corp.'s new recycled linerboard mill in Ontario, Calif.

Recycled medium has become more accepted in the U.S. as a substitute for semichemical medium. Its production has been growing and capacity in 1987 was nearly 1.7 million tons. Major producers of recycled medium and linerboard include Inland, Jefferson Smurfit, Gaylord Container Co., Chesapeake Paperboard Co., and Menominee Paper Co. Inc. The Canadian containerboard industry is based heavily on recycled linerboard and medium. (For further discussion of recycled linerboard corrugating medium, see sections on linerboard and corrugating medium.)

RECYCLED PACKAGING/INDUSTRIAL CONVERTING PAPERBOARD

Gypsum linerboard, which is used on the front and back of gypsum wallboard, is generally made by integrated producers of construction papers and board. The major producers include U.S. Gypsum Co., National Gypsum Co., Georgia-Pacific Corp., Celotex Corp., Republic Gypsum Co., and Domtar Inc. Nonintegrated producers, however, may sell small amounts.

Markets for gypsum linerboard rely on demand for wallboard. However, because there are few products offering comparable value at such low prices, the market is expected to stay strong in the long-term. In the short-term, however, demand can fluctuate quite significantly because it follows the general construction market and interest rates.

During the past decade, U.S. production has fluctuated between 800,000 and 1.1 million tons, according to API statistics. In 1986, production of gypsum wallboard facings gained 10% to about 1.2 million tons, reflecting the

U.S FOLDING BOXBOARD MARKET SHARE BY GRADE

(000 short tons)

		Recycled		Solid bleached sulfate (SBS)		Coated unbleached kraft	
Year	Total	Ton	Share	Ton	Share	Ton	Share
1987	5,413	2,410	44.5%	2,063	38.1%	940	17.4%
1986	5,165	2,286	44.3	1,990	38.5	889	17.2
1985	4,880	2,279	46.7	1,780	36.5	822	16.8
1984	4,876	2,277	46.7	1,847	37.9	752	15.4
1983	4,646	2,211	47.6	1,725	37.1	710	15.3
1982	4,334	2,076	47.9	1,567	36.2	691	15.9
1981	4,588	2,260	49.3	1,655	36.1	672	14.6
1980	4,490	2,234	49.8	1,575	35.1	680	15.1
1979	4,721	2,309	48.9	1,714	36.3	698	14.8
1978	4,702	2,321	49.4	1,763	37.5	618	13.1
1977	4,547	2,367	52.1	1,592	32.8	588	12.9
1976	4,715	2,340	49.6	1,797	38.1	578	12.3
1975	3,896	1,978	50.8	1,456	37.4	463	11.9
1974	4,427	2,281	51.5	1,676	37.9	470	10.6
1973	4,705	2,522	53.6	1,728	36.7	455	9.7
1972	4,440	2,477	55.8	1,573	35.4	390	8.8
1971	4,139	2,408	58.2	1,392	33.6	340	8.2
1970	4,080	2,473	60.6	1,263	31.0	343	8.4
1969	4,262	2,629	61.7	1,346	31.6	287	6.7
1968	4,218	2,730	64.7	1,227	29.1	261	6.2

Source: American Paper Institute.

continued strong construction market.

Core, drum, and tube stocks are used in the manufacture of fiber-based cans, tubes, and drums. The industry is highly integrated, with paperboard producers such as Sonoco Products operating converting operations at its own mills or nearby. Most mills and converting facilities are located near the markets they serve because of high shipping costs on bulky cores, drums, or tubes.

There has been a substantial shift in core, tube, and drum stock market share in the 1980s. In 1982, Container Corp. of America and Owens-Illinois Inc. got out of the business. CCA sold its composite can division to Sonoco. Sonoco later added to that by buying Continental Fibre Drum Inc.'s 13 plants early in 1985. In 1987, Sonoco purchased the Consumer Packaging Div. of Boise Cascade Corp., which included 27 composite can and/or plastic bottle plants.

Another major player in the market, Caraustar Industries' Star Paper Tube Inc., bought Apache Products Inc. early in 1985, bringing the total number of its tube and core plants to 17. Later in 1985, Clevepak Corp. indicated it would sell its Container & Core Div. to an employee group.

API production figures indicate that recycled tube, can, and drum stock rose 4.9% in 1986, bringing the level to a new high. Production rose from 780,000 tons in 1976 to 1.10 million tons in 1986, spurred by increased shipments of cloth and yarn cores and paper mill tubes.

Dept. of Commerce data show, however, that the value of shipments (1982 dollars) of converted composite cans, drums, tubes, cores, and similar products fell by an estimated 3.5% in 1986, marking the third successive year of declining industry sales.

The continuing downward spiral of the industry's major product sector, composite fiber cans, was the principal factor in the decline, which was particularly severe for the industry's long-time biggest product, motor oil quart cans, and to a lesser extent for frozen concentrate juice/drink cans.

Sales of composite cans account for almost half of the industry's shipments, while tubes and cores account for about 30%. The major factor in an approximately 20% decline in composite can sales in 1985 and 1986 was

U.S. AND CANADIAN CAPACITY FOR RECYCLED PAPERBOARD

(000 short tons)

	U.S. annual capacity Recycled paperboard grades					Canadian annual capacity Total boxboard including bleached board
	U.S. total	Paper-board[1]	Folding and setup	Gypsum liner	Other[2]	
1990e	9,529	2,420	2,986	1,406	2,716	—
1989e	9,500	2,410	2,979	1,402	2,709	874
1988e	9,446	2,389	2,967	1,394	2,696	858
1987e	9,252	2,254	2,941	1,385	2,672	845
1986	9,008	2,089	2,934	1,349	2,637	854
1985	8,795	1,998	2,929	1,265	2,603	880
1984	8,722	2,145	2,922	1,249	2,405	880
1983	8,847	2,274	3,014	1,220	2,339	870
1982	8,670	2,130	3,007	1,255	2,298	836
1981	8,600	2,121	2,968	1,251	2,260	873
1980	8,617	2,122	2,942	1,238	2,313	890
1979	8,757	2,111	3,019	1,273	2,355	949
1978	8,642	2,015	2,986	1,238	2,403	938
1977	8,699	2,132	3,117	1,112	2,337	833
1976	8,774	2,235	3,155	1,046	2,337	782
1975	8,717	2,221	3,123	1,063	2,310	785
1974	8,680	2,132	3,170	1,100	2,278	714
1973	8,330	1,833	3,182	1,093	2,221	681
1972	8,185	1,785	3,109	1,082	2,209	659
1971	8,078	1,652	3,292	1,031	2,104	—
1970	8,084	1,697	3,381	1,013	1,993	—

e = Estimate.

[1] Includes linerboard, corrugating medium, and container chip and filler board.

[2] Others include tube, can, and drum stock, special packaging boards, and panel and wallboard stocks.

Sources: American Paper Institute, Canadian Pulp & Paper Assn.

market penetration of plastic cans. Plastic containers with self-pouring spouts have severely eroded markets for composite motor oil cans, which in the late 1970s largely displaced metal cans.

Competition from plastic cans, flexible plastic pouches, aseptic containers, and paperboard, metal, and glass containers caused sales of composite cans for juice/drink concentrates to drop an estimated 4.5% in volume in 1985-86. This compares with a loss of 8.5% during 1984-85, according to the Dept. of Commerce.

Through 1987, the decline in the value of shipments of fiber cans, drums, and similar products was expected to ease slightly, falling 3%. During 1987-91, the industry is expected to grow at an inflation-adjusted annual rate of 1%. The composite fiber can sector will improve modestly, with increased shipments for such uses as pet food, snack food, powdered drink, frozen food, and nonfood containers (see section on converted products).

Plastics are expected to continue capturing market share from composite motor oil quart cans, while shipments of composite frozen concentrate juice/drink cans will remain essentially flat or attain nominal growth. Flexible and aseptic packaging will be increasingly competitive in food-related end uses. Fiber drums will remain the

ESTIMATED CAPACITIES FOR RECYCLED BOXBOARD/PAPERBOARD OF MAJOR U.S. COMPANIES, 1988

	Annual capacity (000 short tons)	Grades*
1. Sonoco Products[1]	750	PB, CS, DS, TS
2. Newark Group[2]	735	CB, BB, CM, PB, TS, SP
3. Container Corp. of America[3]	625	CB, BB, CM, LB, CS, TS, SP
4. Jefferson Smurfit	546	CB, BB, CM, LB, CS, TS
5. Rock-Tenn[4]	532	CB, BB, GL, CS, SP, PB, TS
6. Carauster Industries[5]	480	BB, GL, PB, CS, TS, SP
7. Inland Container[6]	475	CM, LB
8. Waldorf[7]	380	BB, CS, DS, TS, CB
9. U.S. Gypsum	377	GL
10. National Gypsum	320	GL, PB, CB, BB, CS, TS, SP
11. Georgia-Pacific	235	GL
12. Packaging Corp. of America[8]	210	CB, BB, PB, CM, LB, GL
13. Federal Paper Board[9]	175	CB
14. James River[10]	166	CB, BB, CM, LB
15. International Paper[11]	135	LB, SP
16. Simkins Industries	120	CB, BB, SP
17. Menominee Paper	100	LB, CM
18. Chesapeake	85	PB, BB
19. Others	3,000	

* Code: BB-uncoated boxboard; CB-coated boxboard; CM-corrugating medium; CS-core stock; DS-drum stock; GL-gypsum liner; LB-linerboard; PB-unspecified paperboards; SP-specialty paperboards; TS-tube stock.

1. Bought Federal Paper Board Co.'s Richmond, Va., mill in 1988.
2. Bought Lawrence Packaging Corp.'s 200-tpd clay-coated boxboard mill in Lawrence, Mass., in 1985. Bought Federal Paper Board Co.'s Los Angeles, Calif., mill in 1988.
3. Merged with Jefferson Smurfit Corp. in 1986 as affiliate but retained the CCA name. Owned by JSC/MS Holdings, which is jointly held by Jefferson Smurfit and Morgan Stanley Leveraged Equity Fund.
4. Bought Stroudsburg Paperboard Corp.'s 40,000-tpy clay-coated boxboard mill in Stroudsburg, Pa., in 1984. Bought Mead Corp.'s Lynchburg, Va.; Cincinnati, Ohio; and Otsego, Mich., mills in 1987.
5. Bought CCA's mills in Chattanooga, Tenn.; Cincinnati, Ohio; and Chicago, Ill., in 1984.
6. Subsidiary of Temple-Inland Inc. Started up new 175,000-tpy test linerboard mill in Ontario, Calif., in late 1985.
7. Company formed to buy former St. Regis Corp. boxboard mills in St. Paul, Minn., and Battle Creek, Mich., from Champion International Corp., in 1985.
8. In 1983, sold two chipboard mills to Republic Gypsum Corp. and a clay-coated mill in Stroudsburg, Pa. (later sold to Rock-Tenn Co.).
9. Sold Richmond, Va., and Los Angeles, Calif., mills in 1988.
10. Bought Crown Zellerbach Corp.'s paper and board division, including recycled containerboard mills, in 1985.
11. Bought Durham Mills Inc.'s 135,000-tpy Riegelsville, Pa., mill in 1985 but never restarted it.

fastest-growing sector of the industry, although they face competition from bulk corrugated boxes with plastic liners and lighter-weight metal containers. The growth in sales of tubes, cores and similar products will remain modest, according to Dept. of Commerce estimates.

Basestocks for tube, core, and drum stock are made in a variety of basis weights and strength ranges. For cores, the principal test is crush resistance. Typically, a kraft outer ply such as a 13-pt (0.013-in.) virgin kraft wrapper is used for core stock. The inner layers are made from semichemical furnish, high-yield kraft, or recycled furnish. In most cases, recycled boards use, for example, 17-pt (0.017-in.) caliper core stock. In making core or tube stock, the parent rolls are cut into rolls about 5-in. wide. Standard cores have a 3-in. diameter and varying wall thicknesses, with 3/8-in. and 1/2-in. wall thicknesses being common.

ANNUAL U.S. CAPACITY FOR RECYCLED FOLDING AND SETUP BOXBOARDS

(000 short tons)

	Folding	Setup
1990e	2,713	273
1989e	2,707	272
1988e	2,696	271
1987e	2,671	270
1986	2,662	272
1985	2,640	289
1984	2,626	296
1983	2,681	362
1982	2,676	352
1981	2,638	321
1980	2,593	349
1978	2,568	418
1976	2,705	450
1974	2,665	505
1972	2,607	502
1970	2,805	576
1969	3,029	577

e = Estimate.

Source: American Paper Institute.

The production figures for unbleached kraft paperboard for tube, can, and drum stock are not included in the data for recycled paperboard. The Bureau of Census reports that approximately 200,000 tpy are used in this application.

Panel and wallboard stocks are used to manufacture thick, rigid boards used for construction, automobiles, or trailers. The basestock is produced on cylinder board machines and then pasted or laminated together to make panels or wallboards of different thicknesses. Wall and panelboard stocks are made by a limited number of producers. The long-term market for these grades is static, although demand tends to fluctuate with that of trailer production and new construction.

Other recycled paperboard includes a wide range of specialty board for printing and construction, as well as for a variety of specialty packaging uses such as railroad board, poster, mill bristols, and trailers. Specialty uses are expected to continue growing, although at a modest rate with limited production.

FORMING METHODS

In the last two decades, recycled combination board grades have lost much of their competitive edge to fourdrinier board grades, especially to solid bleached sulfate (SBS) paperboard. SBS boards are produced from blends of virgin softwood and hardwood pulps; secondary fiber is rarely used.

ESTIMATED CAPACITIES FOR RECYCLED BOXBOARD/PAPERBOARD OF CANADIAN COMPANIES, 1987

	Annual capacity (000 short tons)	Grades*
Paperboard Industries[1]	550	CB, PB, CM, LB, GL, CS
Atlantic Packaging	120	CM, LB
Beaver Wood Fibre[2]	112	BB, PB, TS, GL
Kruger	103	LB, CS, TS
Domtar	90	LB, CM
Sonoco Products	77	PB, CS, TS
Strathcona Paper	61	BB, PB, SB, CB
Minas Basin Pulp & Paper	33	BB, PB, CS, LB, TS, PB
Others	131	

* Code: BB-uncoated boxboard; CB-coated boxboard; CM-corrugating medium; CS-core stock; DS-drum stock; GL-gypsum liner; LB-linerboard; PB-unspecified paperboard; SP-specialty paperboard; TS-tube stock.

1. Bought Belkin Inc. in 1987.
2. Subsidiary of Georgia-Pacific Corp.

With a fourdrinier, SBS boards can be produced at much higher speeds and with somewhat lower density and MD/CD stiffness or grain ratio than there are for recycled boards. The fourdrinier, however, is limited in the caliper ranges it can offer.

SBS boards are usually produced in calipers ranging from 9 to 28 pt (0.009 in. to 0.028 in.), although they rarely exceed 20 pt (about 75 lb/1,000 ft^2). Cylinder board machines normally produce boards in calipers ranging from 9 to 45 pt (0.009 in. to 0.045 in.), with most cylinder machines able to produce a wide range of combination paperboard, folding and setup boxboards, corrugating medium, gypsum linerboard, and chipboards.

Outside North America, a substantial amount of test linerboard is produced on multi-ply formers. The typical cylinder machine with an open stock-flow system and conventional cylinder mold and vat is limited in its performance. Due to centrifugal forces, it is difficult to operate a conventional cylinder board machine at speeds over 600 fpm. Such grades would have a tensile ratio of 4:1 (MD/CD) and no better than 3:1.

The conventional cylinder mold rotates opposite to the stock flow (counterflow vat). Stock is formed on a wire-covered cylinder mold by pressure differential inside and outside the cylinder mold. The sheet, or ply, is couched off the top of the cylinder by a felt and ply. Counterflow systems produce a sheet with a high machine-direction fiber orientation. With an increase in speed, sheet formation becomes poorer; with significant sheet variations, a decrease in weight pickup results.

Sheet formation can be improved somewhat by using a direct vat where cylinder mold rotation is in the same direction as stock flow. Any additional improvement in formation can be achieved by use of a dry vat. The dry-vat principle, also called "half-vat," was developed by the Boxboard Research & Development Assn.

UPGRADING CYLINDER MACHINES

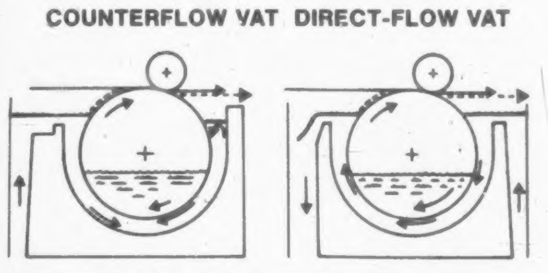
Conventional cylinder formers can be upgraded in a number of ways. The easiest and least expensive way is to add new slice or headbox designs (pressure formers) to existing cylinder machines. This results in better control over grain ratios and improved dewatering. Such units are speed-limited and rarely exceed 600 fpm, however. Units such as the Stevens Former (Beloit Corp.) and Sandy Hill Corp.'s Rotoformer use vacuum suction to increase dewatering.

In the late 1960s, Kobayashi Engineering Works Ltd. introduced its first former, which it called the Ultra Former. This series became known as cylinder-on-top-formers, wherein the sheet is formed and dewatered on top of a cylinder mold or drilled shell and travels downward from the slice to be transferred to the top of a carrier felt of fabric.

The Kobayashi former was designed to replace individual vats on cylinder machines. The Ultra Former permits the felt pickup to wrap the cylinder mold, thus eliminating dropoff, a problem common to conventional cylinder vat machines. The Ultra Former also produces a somewhat lower-density sheet than possible with conventional cylinder machines.

Another new former, the on-top cylinder former with dewatering wires, is designed to be used with fourdrinier formers, but it can be used in some cases in place of a conventional cylinder vat.

Multi-ply boards can also be produced on modified fourdrinier machines. Two approaches are as follows: (1) small fourdriniers are positioned on top of a long fourdrinier section, and (2) on-top formers are positioned on top of a fourdrinier section. Beloit utilizes a different approach for


COUNTERFLOW VAT DIRECT-FLOW VAT

Source: PULP & PAPER, December 1978.

U.S. EXPORTS AND IMPORTS OF RECYCLED PAPERBOARD

(000 short tons)*

	Exports[1]	Imports[2]
1987	329	156
1986	199	104
1985	246	68
1984	169	69
1983	150	50
1982	158	31
1981	174	40
1980	249	57
1979	176	42
1978	203	47
1977	268	28
1976	306	13
1975	262	8
1974	283	34
1973	207	33
1972	163	8
1971	168	17
1970	151	10
1969	143	11

* Data since 1981 from American Paper Institute.

1. Bureau of the Census data for total recycled-furnish paperboard.

2. Bureau of the Census data for test containerboard and other paperboard.

making lightweight multi-ply on a fourdrinier by using a headbox (Strata-Flo/Converflo) that can simultaneously deliver a two- or three-ply sheet to either a fourdrinier wire or a twin-wire former.

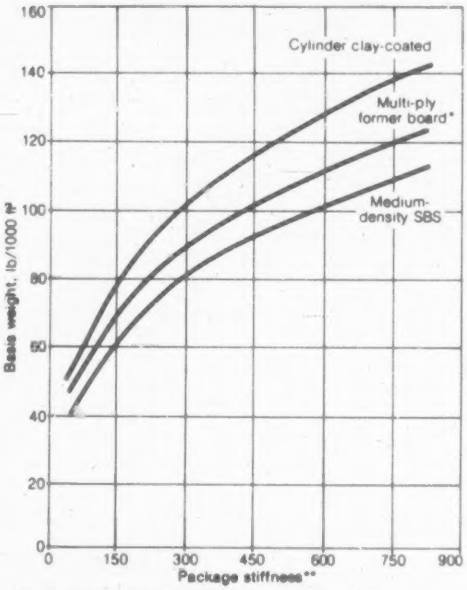
Twin-wire formers made an early debut into multi-ply forming, but they were used on only a limited basis until the 1970s. The first twin-wire former was jointly developed by St. Anne's Board Mill in England and Walmsley Ltd. (Beloit). It was called the Inverform, and it became the forerunner of all twin-wire formers. Inverform units were placed over a conventional fourdrinier table, and considerable dewatering was achieved through the top wire via drainage in an upward direction.

By the 1970s, a number of machine manufacturers had developed their own versions of twin-wire formers. Based on its experience with the Inverform, Beloit developed its Bel Bond former, which has better dewatering and speed characteristics and, like the Inverform, can be positioned over a fourdrinier wire to form a multi-ply board.

Kobayashi's Ultra Former, introduced in 1975, combines flat-forming and centrifugal water removal with a second fabric wire, but the sheet is formed before the meeting of the twin forming fabrics. The sheet is transferred to a felt where it is plied to the preceding layer carried by the felt.

COMPARISON OF PACKAGE STIFFNESS FOR GIVEN FIBER WEIGHT

(SBS board produced on fourdrinier machines, recycled fiber board made on conventional cylinder and on multi-ply formers)



*Assumes basic board density @ 3.5 lb/point/1000 ft² coating weight @ 8 lb/1000 ft²
**Package stiffness = (MD stiffness)$^{0.33}$ X (CMD stiffness)$^{0.667}$
Source: Fibreboard Corp. and Arthur D. Little Inc.

Source: PULP & PAPER, December 1978.

U.S. PRICES FOR RECYCLED BOXBOARD GRADES

($/short ton)

	20-pt clay-coated 80 brights (rolls)	20-pt chipboard bending (rolls)
1988		
3Q	$440/460	$375
2Q	410/430	350
1Q	410/430	350
1987		
4Q	380/400	330
3Q	380/400	330
2Q	355/375	320
1Q	355/375	320
1986		
4Q	380/420*	320*
3Q	370/410*	310*
2Q	370/400*	300*
1Q	350/400*	300*
1985		
4Q	350/400*	300*
3Q	350/400*	300*
2Q	370/425*	300*
1Q	370/425*	300*
Year-end		
1984	370/425*	300*
1983	370/425*	280/300*
1982	380/425*	280*
1981	400/425*	270/280*
1980	380	275
1979	355	260
1978	305	225
1977	284	219
1976	262	212
1975	257	204

* Discounting reported from list prices. Prices on both grades highest on the West Coast and lowest in the Midwest, except for 1987 when prices in the East were lowest.

Source: *Pulp & Paper Week.*

FIBER SOURCES

MARKET PULP

Market pulp is defined as woodpulp produced for sale in open competition with pulp from other producers. It excludes tonnage intended for consumption in the producing mill or for shipment to any mill in Canada or the U.S. which is owned by, controlled by, or affiliated with the producing mill.

There are two basic types of market pulps: (1) dissolving or special alpha pulps and (2) paper-grade pulps. Dissolving and special alpha pulps have a high alpha (pure cellulose) content and are used to make rayon, acetate, and other cellulose derivatives as well as specialty papers. Most paper-grade market pulps are produced by chemical processes, although some are made by mechanical methods such as stone groundwood, thermomechanical, and chemi-thermomechanical pulping.

Chemical paper pulps are further divided into grades based on whether they are made from softwood or hardwood, northern or southern fiber, sulfate (kraft) or sulfite pulping processes, and whether they are bleached, semibleached, or unbleached. Fluff pulp goes into nonpaper applications, such as baby diapers, but is included in paper-grade pulp for statistical purposes. Most paper-grade market pulp is cut into sheets and sold in bale form, but some is sold in rolls, and a small amount is flash-dried and baled.

Integrated paper mills can sell captive pulp on the open market when internal pulp demand is low. When pulp demand is high, these integrated mills may become net pulp buyers or may shift tonnage to affiliated paper mills. Dissolving pulp mills can produce either chemical cellulose or paper-grade pulps. As a result, market pulp capacity ratings are inexact and vary with market conditions.

CHEMICAL PAPER-GRADE MARKET PULP

North American market **sulfite pulp** production in 1950 exceeded sulfate production, and for many years sulfite pulps were considered the most desirable type for papermaking. But by 1987, production in the U.S. and Canada of bleached and unbleached sulfite market pulp dropped to only 545,000 metric tons and accounted for only about 4% of total North American chemical paper-grade market pulp production. This trend is expected to continue gradually, with the shutdown of small, older mills and with few new sulfite pulp mills being built. (One exception was Fraser Inc.'s recent expansion of its Atholville, N.B., sulfite mill). The same declining trend has taken place in the Nordic countries, where sulfite now accounts for about 11% of chemical paper-grade market pulp capacity.

Most North American sulfite pulp is produced from northern and eastern softwoods (spruce, pine, fir, and hemlock). One sulfite mill in the U.S. South—ITT

STATISTICS FOR MARKET PULP

(000 metric tons)

	1988e	1987	1986
UNITED STATES			
Production, 000 tons	6,365	6,186	5,729
Annual capacity, 000 tons	6,400e	6,147	6,015
Utilization rate, %	99.0	101.0	95.0
Apparent consumption, 000 tons	5,355	5,216	4,893
Imports, 000 tons	2,740	2,680	2,568
Exports, 000 tons	3,750	3,650	3,404
CANADA			
Production, 000 tons	7,310	7,203	6,597
Annual capacity, 000 tons	7,450e	7,320e	7,151
Utilization rate, %	98.0	98.0	92.0

e = *Pulp & Paper* estimate.

Sources: American Pulp & Paper Assn., Canadian Pulp & Paper Assn., U.S. Dept. of Commerce.

Rayonier Inc. at Fernandina Beach, Fla.—produces paper-grade and dissolving pulp grades from southern pine. A few U.S. and Canadian mills produce sulfite pulp from hardwoods. Sulfite pulps are still highly desirable for producing high-quality tissue and printing/writing papers.

Bleached sulfate (kraft) is the predominant grade of market pulp, with Canadian and U.S. production in 1987 totaling 12.6 million metric tons (including semibleached pulp). The largest percentage of production is made from softwood fibers such as spruce, fir, and pine. Bleached kraft softwood output totaled 5.9 million tons in Canada and 3.4 million tons in the U.S. in 1987. The most preferred softwood pulps generally are those from mills in western and eastern Canada, northeastern U.S., and to a lesser extent the U.S. Pacific Northwest (where some mills use less desirable species such as pine and redwood).

Southern pine pulps are somewhat lower in quality, as the fiber is coarser and produces a poorer sheet for printing/writing grades. Because more southern pine pulp is available, papermakers have learned how to use increasing amounts in most white paper grades. Nevertheless, southern pine pulps normally sell at about a $30/metric ton discount from premium northern bleached softwood kraft (NBSK) pulp, and in weak markets the differential may be larger.

Bleached hardwood sulfate market pulps are produced in the U.S. Northeast and South, with a small amount also produced in eastern Canada. Hardwood accounts for about 41% of U.S. and 13% of Canadian bleached sulfate market pulp production. Canadian and U.S. hardwood normally sells at about a $10/metric ton premium to southern U.S. hardwood. In Europe, birch is a preferred northern hardwood species.

Southern hardwood pulps are normally sold as mixed hardwoods, with or without oak. Oak and some other species high in vessels have caused excess picking on offset printing grades. However, papermakers in the last 25 years have reduced the picking tendency of oak-containing pulps so that these problems are not too serious for printers.

U.S. PRODUCTION OF MARKET WOODPULP

(000 metric tons)

Year	Total all grades	Dissolving and special alpha	Bl. & unbl. sulfite	Total bl. & semibl. sulfate*	Bl. & semibl. softwood sulfate	Bl. & semibl. hardwood sulfate	Unbl. sulfate
1987	6,236	1,213	221	5,799	3,437	2,362	166
1986	6,849	1,138	204	5,385	3,295	2,090	140
1985	6,156	1,063	202	4,756	3,075	1,681	135
1984	6,245	1,093	238	4,775	3,035	1,740	139
1983	5,911	1,145	208	4,430	2,752	1,678	128
1982	5,200	988	187	3,914	2,558	1,356	111
1981	5,626	1,224	241	4,030	2,559	1,471	131
1980	5,865	1,366	345	3,971	2,480	1,491	119
1979	5,151	1,360	250	3,381	2,084	1,298	102
1978	4,647	1,273	227	2,985	1,785	1,200	88
1977	4,358	1,327	211	2,626	1,673	953	124
1976	4,413	1,243	287	2,721	1,659	1,062	102
1975	3,953	1,118	292	2,423	1,777†	891†	79
1974	4,663	1,461	360	2,635	1,428†	1,093†	173
1973	4,468	1,356	441	2,552	1,384†	1,040†	100
1972	4,559	1,519	436	2,454	1,300†	1,023†	106
1071	4,204	1,524	378	2,109	1,096†	842†	200
1970	4,491	1,555	534	2,487	1,190†	1,075†	386
1965	3,486	1,347	563	1,298	n.a.	n.a.	214
1960	2,717	1,019	526	897	n.a.	n.a.	262
1955	2,429	880	551	767	n.a.	n.a.	204
1950	1,454	428	604	261	n.a.	n.a.	113

* Includes soda pulp.
† Excludes semibleached.
n.a. = Not available.

Source: American Paper Institute.

The hardwood pulps, blended with or without softwood pulps, make an excellent printing/writing grade, providing bulk and a good printing surface. Hardwood kraft market pulps are generally sold at $20 to $25/ton discount from softwood kraft grades produced in the same region.

A newer type of hardwood pulp not produced domestically but increasingly popular in North America and with papermakers around the world is bleached eucalyptus kraft pulp. About 15% of U.S. hardwood pulp consumption now consists of eucalyptus pulp from Brazil, with another 1% to 2% from Spain and Portugal. Since breaking into the world pulp scene about a decade ago, eucalyptus shipments have grown from 434,000 tons in 1976 to about three million tons currently. Originally, the reason for this popularity was lower cost combined with desirable performance features ranging from opacity in printing/writing papers to softness in tissue. As a result, eucalyptus has become a preferred pulp and now sells at a price at least equal to the best northern hardwood grades in Europe and the U.S.

Of the estimated 3.2 million tons of bleached eucalyptus market pulp capacity in the world in 1988, about 38% is in Brazil, 30% in Spain, 25% in Portugal, 4.6% in South Africa, and 2.5% in Morocco. Eucalyptus can be grown rapidly in plantations. The time required for a eucalytpus plantation to reach maturity in Brazil is about seven years compared with roughly 20 years for southern U.S. loblolly pine and perhaps 80 years or more for Canadian spruce and fir. Eucalyptus plantations in Brazil will produce more than 40 m^3/hectare annually—about 20 times the growth rate of the average Canadian forest or almost three times that of a U.S. southern forest—said Ronald J. Slinn, vice president, Pulp Materials & Technology Group, American Paper Institute. Productivity is somewhat lower in Spain and Portugal but higher than in the southern U.S.

Unbleached kraft market pulp production has declined in North America. Total production in 1987 of 285,000 tons accounted for only about 2% of North American chemical paper-grade market pulp production. About 40% of unbleached kraft market pulp in the U.S. is used in one-time carbonizing tissue, a market that is shrinking due to inroads by carbonless copy paper. Other end uses for unbleached kraft market pulp are filter papers, cable wrap, condenser papers, twisting grades, and other specialties.

NORTH AMERICAN INDUSTRY STRUCTURE

The U.S. pulp and paper industry is highly integrated and market pulp accounts for only a small percentage of total woodpulp production or consumption.

U.S. MARKET WOODPULP CAPACITY

(000 metric tons)

Year	Total all grades	Dissolving	Chemical paper grades	Bleached softwood sulfate[1]	Bleached hardwood sulfate[1]	Unbleached sulfate	Sulfite	Others
1990e	7,660	1,262	6,387	3,529	2,429	170	259	13
1989e	7,669	1,262	6,395	3,510	2,457	170	259	13
1988e	7,620	1,261	6,346	3,486	2,432	170	259	13
1987	7,407	1,249	6,147	3,396	2,325	168	259	13
1986	7,293	1,266	6,015	3,398	2,224	132	260	13
1985	7,247	1,312	5,923	3,386	2,133	131	274	13
1984	6,831	1,349	5,469	5,063		132	274	13
1983	6,726	1,378	5,335	4,874		142	319	13
1982	6,422	1,450	4,986	4,572		129	261	11
1981	6,325	1,432	4,876	4,416		151	309	15
1980	6,170	1,430	4,653	4,163		156	335	87
1979	5,746	1,407	4,247	3,836		94	318	92
1978	5,213	1,427	3,691	3,314		97	280	94
1977	4,960	1,461	3,498	2,975		149	273	101
1976	4,905	1,289	3,616	2,896		198	416	105
1975	4,910	1,350	3,560	2,919		192	417	31
1974	5,041	1,484	3,557	2,940		173	427	17
1973	4,867	1,442	3,425	2,814		134	458	18
1972	4,910	1,560	3,349	2,774		124	451	—
1971[2]	4,498	1,597	2,901	2,251		218	432	—

e = Estimate.

1. Includes semibleached.
2. First year in which market pulp capacity was reported by API.

Source: American Paper Institute.

Of the 76 U.S. companies that produce paper-grade pulp, only 30 sold any pulp in 1987, according to Slinn. Many of the 223 companies in the U.S. paper industry also buy significant quantities of pulp, but at least 156 must purchase all of the fiber they require, including wastepaper.

In 1987, the U.S. paper industry produced 52.9 million metric tons of chemical paper-grade pulp, of which 84% was consumed on site, 4% was shipped to affiliated mills within the U.S., 5% was shipped to the domestic market, and 7% was exported, according to API. Apparent U.S. paper-grade woodpulp consumption in 1987 totaled 53.3 million tons, of which 83% was supplied from integrated sources within the U.S., 4% was derived from U.S. affiliates, 5% from the domestic market, and 8% from imports.

U.S. paper pulp imports in 1987 totaled 4.1 million tons, of which 91% was supplied by Canadian producers. The remaining 9% came from Brazil, the Nordic countries, Chile, and Iberia.

Canadian paper-grade pulp shipments to the U.S. in 1987 were 3.8 million metric tons, of which 34% consisted of "tied" shipments from Canadian affiliates of U.S. paper companies.

In contrast to the U.S., market pulp accounts for a large share of total Canadian chemical paper-grade woodpulp production, which totaled about 12.6 million metric tons in 1987. Of this, 34% was consumed on site or by affiliated mills, 7% was shipped as market pulp to domestic mills, 27% was shipped to the U.S. (including roughly 1.04 million tons of "tied pulp"), and 32% was exported abroad, according to Canadian Pulp & Paper Assn. data. About 30 companies in Canada sell chemical paper-grade market pulp.

Paper-grade market pulp is used principally in three paper grades in the U.S.: (1) uncoated free-sheet; (2) coated printing and publication papers; and (3) tissue. The remainder is used in such grades as packaging and industrial converting grades, bristols, and bleached board.

As a result, U.S. demand for market pulp is closely related to the level of U.S. paper production, particularly the printing/writing grades. In recent years, when U.S. printing/writing paper mill operating rates exceeded the low 90% range, the amount of white market pulp consumed in relation to total white pulp usually rose above 20%. If paper production is below 90%, however, the ratio of market to total paper pulp consumption often drops into the 18% to 19% range. (White pulp includes bleached and semibleached kraft and bleached and unbleached sulfite.)

The shift in this ratio can cause dramatic changes in U.S. market pulp consumption. In the 1983 recovery, for example, white paper production rose 11.4%, with mill operating rates climbing to 95.3% from 87.7% in 1982.

MACHINE-DRIED WOODPULP CAPACITY

(000 metric tons)

Year	Total	Dissolving	Bleached sulfite	Bleached sulfate	Unbleached sulfate	Other
1990e	9,693	1,266	370	7,778	171	108
1989e	9,700	1,266	370	7,785	171	108
1988e	9,685	1,266	370	7,771	171	108
1987	9,529	1,254	370	7,628	168	108
1986	9,443	1,269	367	7,568	132	108
1985	9,315	1,313	358	7,417	130	106
1984	8,850	1,349	364	6,904	132	100
1983	8,618	1,455	377	6,555	132	99
1982	8,615	1,457	406	6,521	137	94
1981	8,462	1,450	450	6,291	172	98
1980	8,304	1,442	472	6,052	171	170
1979	7,779	1,393	486	5,625	99	176
1978	7,432	1,427	516	5,204	107	176
1977	7,235	1,495	579	4,818	161	181
1976	7,170	1,425	714	4,642	205	183
1975	7,167	1,516	709	4,608	217	119
1974	7,235	1,655	740	4,555	193	93
1973	6,994	1,596	728	4,392	191	88
1972	6,807	1,593	709	4,266	226	10
1971	6,717	1,605	609	4,173	245	4
1970	6,574	1,604	755	3,977	237	1

e = Estimate.

Source: American Paper Institute.

Total U.S. white pulp apparent consumption rose 7.6%, but white market pulp consumption jumped 18.3%.

The main reason for this swing is that many integrated companies must supplement their own pulp supplies when running at full capacity by purchasing fiber on the open market. At the same time, the available supply of market pulp may contract as paper production levels rise and companies first try to meet their own integrated requirements. Thus, unlike most commodities, the supply of market pulp tends to decline as demand rises—a factor that no doubt contributes to market pulp's cyclicality.

INTERNATIONAL MARKET

The pulp market is international in nature, with large volumes of pulp moving duty-free between net producing regions and net consuming regions. North America and Nordic countries are the largest market pulp producing regions, although nontraditional supplying countries with fast-growing plantations—Brazil, Portugal, Spain, and Chile—are growing in importance.

North American and Nordic shipments of chemical paper-grade market pulp in 1987 reached a new peak of 18.5 million metric tons, up 6.1 from 1986. Canada remained the single largest market pulp producing country with shipments of 7.3 million tons, up 7.3%. The U.S. was second with shipments of 6.2 million tons, up 5.4%. Nordic shipments totaled nearly 5.0 million tons, up 5%. Shipments from non-Norscan supplying countries totaled 7.9 million tons, bringing world shipments (excluding communist countries) to 26.4 million tons.

Since 1978, the share of world shipments from the North American and Nordic countries has declined from 79.8% in 1978 to 69.4% in 1986, while the share held by nontraditional countries has increased from 20.2% to 30.6%. In 1987, however, traditional producers showed stronger shipment growth and captured about 70% of the market. Nontraditional or "other" producers increased shipments by only 2% in 1987—considerably below their 6% average annual growth rate of the last decade.

During the past decade, chemical paper-grade market pulp shipments from U.S. and nontraditional producing countries have more than doubled, according to David F. McCaffrey, director of woodpulp for CPPA. Canada's shipments have grown by a smaller 36%, but this was still a nearly 2.0-million-ton increase. Nordic shipments rose by only 340,000 tons, or about 7%, reflecting forward integration into printing/writing papers production, particularly since the beginning of the 1980s.

Western Europe (excluding Scandinavia) remains the

U.S. EXPORT TRENDS FOR WOODPULP

(000 metric tons)

	Total all grades	Dissolving and special alpha	Sulfite bleached	Sulfite unbleached	Sulfate bleached	Sulfate semi-bleached	Sulfate unbleached	Other
1987	4,392	681	338	35	3,310	7	141	24
1986	4,044	645	288	24	2,886	17	131	53
1985	3,443	572	227	20	2,474	37	86	26
1984	3,260	540	239	9	2,272	69	82	49
1983	3,306	587	255	12	2,277	52	87	36
1982	3,080	573	190	7	2,139	57	90	25
1981	3,336	720	247	11	2,193	60	92	22
1980	3,452	698	292	23	2,180	84	103	73
1979	2,662	693	199	34	1,481	97	94	64
1978	2,358	687	172	18	1,270	84	69	56
1977	2,395	722	175	7	1,174	147	95	74
1976	2,284	662	164	11	1,180	95	103	67
1975	2,327	628	223	21	1,427	117	87	38
1974	2,252	714	259	22	1,308	81	141	16
1973	2,126	668	266	6	1,003	114	65	5
1972	2,044	720	205	2	1,092	115	70	3
1971	1,974	717	184	9	787	132	137	8
1970	2,808	778	326	31	1,192	223	230	11
1969	1,907	674	228	13	733	138	115	7
1968	1,738	609	206	8	578	191	134	11
1967	1,561	551	219	12	471	179	120	9
1966	1,404	511	190	24	326	126	99	9
1965	1,272	485	183	35	329	126	155	6

Source: U.S. Dept. of Commerce.

largest destination for world chemical paper-grade market pulp shipments, accounting for about 40% of total shipments. In 1987, Western Europe consumed 10.5 million tons of pulp, up 1.6% from 1986. The U.S. was the second-largest market, consuming 5.3 million tons, up about 3.8% from the previous year. Japan was the third largest market with demand of 2.8 million tons, up 7.1%. Other regions of the world—Asia, Latin America, and Africa—consumed nearly 5.7 million tons of market pulp in 1987, up 11.6% from 1986.

PULP MARKET CYCLES

The pulp market is highly cyclical, characterized by sharp inventory swings and rising or falling prices. When prices begin to rise, buyers rush to stock up on pulp. Rising shipments enable producers to run at full capacity and reduce their inventories. The tightening market emboldens producers to demand still higher prices. This triggers another surge of buying and another spiral upward in the market cycle.

High pulp prices cause consuming paper mills to try using other substitutes such as secondary fiber (wastepaper) or to increase their captive pulp production. Prices may still rise after actual pulp consumption by paper mills has begun to decline. At some point, buyers realize that more than enough pulp is available and begin to reduce their inventories. Prices start to weaken and buyers hold off on making any purchases in anticipation of still lower prices, and the downward market spiral is under way.

Market pulp cycles are also related to underlying demand and supply conditions. Demand for market pulp is affected by production levels for paper and paperboard, which in turn reflect general economic activity. But pulp market cycles tend to lag behind general economic activity. In the U.S., there has generally been about a two- to three-year lag between turning points in the economy and changes in pulp prices, said Ross Hay-Roe, editor, *PaperTree Letter*.

Capital investment in the market pulp industry usually comes in surges during periods of rising prices and profitability. It usually takes two to three years to build a new mill. Once the wave of new capacity comes onstream, the market may have weakened, resulting in oversupply and declining prices. As profitability declines, companies pull in the reins on capital spending, slowing down capacity expansion and setting the stage for the next period of market tightness.

Among barometers used to gauge price changes in the pulp market are North American and Nordic producer inventories and operating rates for chemical paper-grade market pulp. Historically, market pulp prices tend to rise when ratios of shipments to capacity reach about 87% to 88% and when inventories of North American and Nordic producers drop to around 1.2 to 1.3 million tons. When operating rates decline below this level and inventories increase, prices usually (but not always) begin to weaken.

API's Slinn noted that a curiously consistent two-year nine-month time span existed between peaks and troughs in North American and Nordic producer inventory levels from about 1970 to 1982. This made the entire cycle (from

SOURCES OF U.S. WOODPULP NEW SUPPLY

(000 metric tons)

	Total new supply	Captive	Market			
			Total	U.S.	Canada	Other
1986p	51,836	46,046	5,656	2,824	2,258	574
1985	49,694	44,484	5,210	2,738	2,118	354
1984	51,167	45,011	6,156	3,074	2,725	358
1983	48,145	42,685	5,460	2,773	2,388	300
1982	45,200	40,670	4,529	2,348	1,931	250
1981	47,866	42,654	5,212	2,596	2,363	253
1980	46,496	41,133	5,363	3,678	2,556	129
1979	46,131	40,131	5,275	2,615	2,491	168
1978	43,897	38,932	4,965	2,434	2,366	165
1977	43,311	38,643	4,667	2,231	2,291	146
1976	42,466	37,771	4,695	2,353	2,214	129
1975	37,339	33,742	3,596	1,792	1,729	75
1970	37,504	32,979	4,525	2,396	2,002	126
1965	30,442	26,267	4,175	2,226	1,662	283
1960	22,855	19,815	3,040	1,690	1,036	314
1955	19,031	15,639	3,392	1,914	1,165	314
1950	14,565	11,421	3,144	1,414	1,124	604

Note: Total woodpulp, including dissolving pulp.

Sources: American Paper Institute, U.S. Dept. of Commerce.

peak-to-peak or trough-to-trough) slightly more than five years. However, the pattern broke down in 1982 when a nine-week strike in British Columbia caused producer inventories to hit a low of 911,000 tons in March 1984 after only one year and seven months. The next peak of 1.8 million tons came after only 11 months, in February 1985.

In addition to labor negotiations (particularly in British Columbia), another external factor that can affect the pulp market are actions by government. Producer inventories hit an all-time high of 2.9 million tons in February 1977 due to a Swedish government program to subsidize inventory building in order to keep employment levels high.

Exchange rate fluctuations have also had a growing impact on pulp prices. Fluctuations in the value of the dollar upset comparative cost relationships among major producing regions and affect the price of pulp for buyers in terms of their local currencies. The rise of the dollar during the 1980-84 period dramatically increased the cost advantage of Scandinavian and nontraditional producers and enabled them to price pulp more competitively. At the same time, weak currencies increased the cost of dollar-priced pulp for buyers in Europe and other overseas markets and made them more resistant to pulp price increases. The decline of the dollar since 1985 has dramatically improved the cost position of North American producers and made price increases easier for buyers in Europe and Japan to accept.

Under 1984 price-fixing settlements with the European Community, Nordic producers price their pulp in European currencies. Although this measure was intended to reduce the "transparency" of the market, local currency prices in fact tend to equalize with the dollar price of pulp. The ruling was designed to help European pulp buyers being "scissored" between expensive dollar-priced pulp and increasing shipments of Nordic white paper pulp to the Continent priced in local currencies. But, ironically, not long after the ruling was made the dollar began to decline.

CURRENT MARKET CONDITIONS

Since a severe downturn in 1985, the world pulp market has staged a dramatic recovery that is still under way. The price of benchmark northern bleached softwood kraft pulp in

U.S. MARKET PULP MILLS—SUMMARY OF STATISTICS

Year[1]	All establishments		Employees		Value added by manufacture (million $)	Cost of materials (million $)	Value of shipments (million $)	New capital expenditures (million $)
	Total (number)	With 20+ employees (number)	Number (000)	Payroll (million $)				
1982 Census	43	41	16.7	$467.9	n.a.	$1,986.5	$3,129.0	$658.6
1981 ASM	n.a.	n.a.	15.9	408.1	$1,221.7	1,960.1	3,141.8	521.5
1980 ASM	n.a.	n.a.	16.2	404.6	1,292.7	1,776.9	3,031.9	258.8
1979 ASM	n.a.	n.a.	15.7	338.9	1,117.2	1,417.2	2,544.1	239.7
1978 ASM	n.a.	n.a.	15.1	306.3	855.5	1,268.0	2,152.4	194.6
1977 Census	45	42	16.2	293.2	885.7	1,212.4	2,071.1	301.1
1976 ASM	n.a.	n.a.	15.7	260.5	974.6	1,087.7	2,055.4	375.0
1975 ASM	n.a.	n.a.	13.1	191.4	821.0	837.0	1,630.4	294.2
1974 ASM	n.a.	n.a.	12.0	163.2	779.3	766.1	1,525.2	135.6
1973 ASM	n.a.	n.a.	10.8	138.2	382.7	464.0	848.5	118.7
1972 Census	60	35	10.6	125.7	306.9	388.1	709.9	136.4
1971 ASM	n.a.	n.a.	14.5	156.3	367.2	496.4	841.8	135.2
1970 ASM	n.a.	n.a.	15.6	160.2	466.3	508.3	960.3	121.6
1969 ASM	n.a.	n.a.	14.9	142.6	362.0	455.2	820.0	132.6
1968 ASM	n.a.	n.a.	15.4	136.0	361.3	431.2	799.3	77.0
1967 Census	61	43	15.1	125.6	333.7	403.2	730.5	121.8
1966 ASM	n.a.	n.a.	14.8	112.3	346.1	320.1	658.5	113.3
1965 ASM	n.a.	n.a.	14.8	112.3	346.1	320.1	758.5	112.2
1964 ASM	n.a.	n.a.	15.3	113.6	331.6	328.6	662.8	66.6
1963 Census	45	40	15.1	107.4	295.8	312.6	609.1	38.9

n.a. = Not available.

1. In years of Annual Survey of Manufactures (ASM), data are estimates based on a representative sample of establishments canvassed annually and may differ from results of a complete canvass of all establishments.

Source: 1982 Census of Manufactures.

Europe rose for ten consecutive quarters, from a discounted level of about $380 to $390/metric ton in late 1985 to a price of $725 in the second quarter of 1988—for a stunning 88% increase. Another roughly $35/ton increase seems likely in the third quarter of 1988.

The main factors behind this dramatic recovery are steadily growing paper production (reflecting the six-year economic expansion), limited world pulp capacity additions, and the decline of the dollar. The decline of the dollar improved the competitive cost position of North American producers and made recent price increases easier to accept for customers in Europe and Japan. As a result, pulp producers—particularly those in North America—are enjoying a period of unprecedented prosperity.

World pulp shipments set new highs during the past five years, and they grew at a slightly more than 4% average annual rate during the last decade. In 1987, shipments hit 26.4 million tons, up 4.8% from the previous year. At the same time, world capacity growth slowed down. In Norscan (North America and the Nordic countries), capacity this decade rose a total of only 9% vs 23% growth in the 1970s. There has also been a dearth of expansion in the nontraditional producing countries over the last several years.

As a result, world pulp demand is increasingly pushing up against supply. In 1987, North American and Nordic mills ran at 97% of capacity, up from 91% in 1986. Producer inventories at the end of 1987 dropped to an eight-year low of 691,000 metric tons (equal to only 13 days of supply). The market grew increasingly tight during the first half of 1988, with softwood pulp in particularly short supply. Through the first quarter of 1988, North American and Nordic mills ran at 101% of capacity—probably an unsustainable rate. Customer inventories are rising gradually, but they are restrained by the tight market situation. Paper mill inventories were reported to be moderate in the U.S. and moderate-to-higher in Europe and Asia.

With the continuing strength in printing/writing papers production in the first half of 1988, there was increasing concern about market pulp supply. Printing/writing papers shipments in the U.S., Japan, and some European countries

RELATIONSHIP OF PRINTING/WRITING PAPER PRODUCTION LEVELS TO MARKET PULP CONSUMPTION—U.S.

(000 metric tons)

	Printing/ writing paper production	Printing/ writing paper mill operating rates	Total white pulp apparent consumption*	Market white pulp apparent consumption*	Market as a percent of total white pulp consumption
1986	17,845	93.8%	n.a.	n.a.	n.a.
1985	16,756	90.3	22,823	4,430	19.4%
1984	16,687	92.5	22,803	5,302	23.3
1983	15,757	93.2	21,432	4,580	21.4
1982	14,162	87.7	20,054	3,816	19.0
1981	14,263	90.9	20,404	4,271	20.5
1980	14,131	92.7	19,804	4,331	21.9
1979	13,929	95.6	19,770	4,284	21.7
1978	13,252	93.8	18,828	3,952	21.0
1977	12,607	92.8	18,436	3,565	19.3
1976	12,021	91.4	17,855	2,684	20.6
1975	9,990	77.1	15,617	2,881	18.4
1974	12,233	95.4	17,752	3,669	20.7
1973	12,179	98.3	17,255	3,650	21.2
1972	11,119	96.0	16,122	3,487	21.6
1971	10,152	89.9	15,156	3,044	20.1
1970	9,941	89.7	14,932	3,046	20.4
1969	10,160	91.6	14,877	3,460	23.3
1968	9,561	90.5	14,059	2,845	20.2
1967	9,187	90.3	13,246	2,753	20.8
1966	9,365	96.2	12,898	2,939	22.8

* New supply (production + imports – exports.)
n.a. = Not available.

Source: American Paper Institute.

were up about 9% to 10% in the first quarter. However, world chemical-paper grade market pulp capacity was forecast to rise by only 250,000 tons or less than 1% in 1988—clearly not enough to meet the strong demand. Another major uncertainty was labor negotiations involving British Columbia's pulp mills, where contracts expire June 30. British Columbia accounts for about 20% of North American and Nordic pulp supply, and any major disruption would send the pulp market into turmoil. Talks were reportedly off to a good start in the spring.

Where will the pulp come from to satisfy demand? For one thing, capacity levels will probably be revised slightly upward this year due to debottlenecking at existing pulp mills, production shifts from dissolving and fluff grades to paper pulp, reactivation of idle equipment, and swing tonnage from bleached board machines. Such factors caused API to revise U.S. market pulp capacity upward by 400,000 tons in 1987. Customers will also attempt to increase their internal pulp production or use more secondary fiber.

Another factor that should help supply is about 600,000 tons of new bleached chemi-thermomechanical market pulp capacity which will come on line in Canada over the next two years. This will represent production from three new mills and expansion of a fourth (see mechanical pulp section). Although there has been some skepticism about the new mechanical pulp, the tight market situation will encourage papermakers to find ways to blend it into their furnishes.

Given the tight supply situation and weakness of the dollar, pulp prices will probably continue to rise through the remainder of 1988 and possibly into the first quarter of 1989. If there is no labor disruption in British Columbia, pulp supply could ease somewhat in late 1988. However, low inventory levels, the fact that many mills are behind on shipping schedules, and pent-up buyer demand should keep the market in fairly good balance. Hay-Roe of *PaperTree Letter* projected that pulp prices will peak at the end of 1988 or early 1989 at around $800/ton for northern bleached softwood kraft.

As previously noted, pulp prices have a tendency to lag downturns in the U.S. economy for about two years. Because there is no recession yet, pulp prices should be relatively firm at least through 1989 and possibly into 1990. Then rising inventory levels caused by the long-predicted economic slowdown and growing concern about the next wave of capacity expansion will probably result in the next market downturn.

CANADIAN PRODUCTION OF MARKET WOODPULP BY GRADES

(000 metric tons)

	All grades	Dissolving and special alpha	Sulfite bleached	Sulfite unbl.	Sulfate & soda bleached & semibl.	Sulfate unbl.	Mechanical
1987	—	241	308	16	5,906	119	—
1986	6,601	223	289	18	6,174	121	545e
1985	6,652	222	204	13	5,601	151	461
1984	6,729	221	234	28	5,558	155	533
1983	6,690	217	186	29	5,687	180	390
1982	5,823	219	160	47	4,894	184	319
1981	6,540	275	266	72	5,514	230	183
1980	7,156	313	271	90	6,005	242	235
1979	6,619	367	275	83	5,407	253	234
1978	6,132	334	262	75	5,037	215	209
1977	5,903	269	327	52	4,709	296	250
1976	5,954	254	368	81	4,703	287	261
1975	4,889	228	315	67	3,778	279	221
1974	6,286	351	356	156	4,746	405	272
1973	5,743	251	265	83	4,421	449	274
1972	5,021	253	282	83	3,384	328	241
1971	4,620	288	310	113	3,416	273	220
1970	4,857	326	389	187	3,379	297	279
1965	3,169	306	519	265	1,570	209	300
1960	1,908	198	309	166	771	222	242
1955	1,876	324	361	322	383	205	281
1950	1,356	293	232	339	142	193	159

e = Estimate.

Source: Canadian Pulp & Paper Assn.

NEW EXPANSION WAVE

High pulp price levels and improving return on investment have stimulated a wave of expansion activity in chemical paper-grade market pulp. Through May 1988, about nine new market pulp mills were announced worldwide —two in North America, one in Europe, and five in Latin America. These new greenfield mills plus major incremental expansions would add about 4.5 million metric tons to total world chemical paper-grade market pulp capacity by 1992 (including only definite projects). Total world capacity would rise to an estimated 31.2 million tons in 1992 from 26.7 million tons in 1987. This would represent a 16.7% increase over the five-year period—or about 3.3%/year. By contrast, world chemical paper-grade market pulp shipments rose at about a 2.6% average annual rate from the last cyclical peak in 1974 to what may be a near peak in 1987.

The projected rate of capacity growth may be somewhat overstated because of integration projects at existing market pulp mills, because not all of the new pulp capacity is for market sale, and because of the time it takes new mills to reach design capacity. On the other hand, another 2.4 million tpy of chemical market pulp capacity is under study, and some of these projects may move ahead. In addition, more than 800,000 tpy of chemi-thermomechanical pulp is expected to be added during the 1987-89 period. As a result, a period of excess pulp capacity will likely develop sometime in the early 1990s.

In North America, Weyerhaeuser Co. is building a 425,000-tpy pulp bleached kraft pulp line at its Columbus, Miss., mill, while Daishowa Paper Manufacturing Co. of Japan is going ahead with plans to build a new 340,000-tpy hardwood kraft mill in Alberta. Other major incremental expansions are under way at Weldwood of Canada Ltd.'s Hinton, Alta., mill and by Howe Sound Pulp & Paper Ltd. (a joint venture between Canfor Corp. and Oji Paper Co. of Japan) at Port Mellon, B.C.

The new capacity will be partially offset by integration projects at several existing North American market pulp mills over the same period, totaling about 500,000 tons. These projects and estimated market pulp loss include: Weyerhaeuser Canada Ltd.'s uncoated free-sheet machine at Prince Albert, Sask. (160,000 tpy); Champion International Inc.'s coated free-sheet machine at Quinnesec, Mich. (160,000 tpy); Great Lakes Forest Products Ltd.'s uncoated free-sheet machine at Dryden, Ont. (175,000 tpy).

The greatest expansion activity is taking place in Latin America. In Chile, three new pulp mill ventures have been announced, two involving U.S. paper companies (Scott Paper Co. and Simpson Paper Co.). In Brazil, three of four eucalyptus projects appear likely to move ahead during the first half of the 1990s. Aracruz Celulose SA has already begun work to double the size of its eucalyptus mill, while Bahia Sul Celulose (a joint venture between Suzano de Papel e Celulose and the big mining firm Companhia Vale Rio Doce) seems to be moving ahead with plans for a new

CANADIAN MARKET PULP CAPACITY

(000 metric tons)

	Total	Dissolving & special alpha	Sulfite bleached	Sulfite unbleached	Sulfate bleached softwood	Sulfate semibl.	Sulfate bleached hardwood	Sulfate unbl.	Mechanical
1989e	8,489	253	312	16	5,537	508	749	134	980
1988e	8,355	353	313	16	5,527	499	840	135	752
1987e	8,120	253	302	23	5,442	524	839	135	602
1986	7,985	245	292	24	5,396	501	809	129	589
1985	7,769	266	270	35	5,233	420	794	177	574
1984	7,670	264	240	39	5,134	405	869	198	521
1983	7,641	201	250	72	5,130	453	780	208	500
1982	7,617	305	286	83	5,128	438	669	236	472
1981	7,430	303	313	84	5,056	433	634	290	317
1980	7,237	307	265	95	4,905	550	605	270	240
1979*	7,112	395	257	106	4,733	524	579	253	265
1978	7,381	424	354	187	4,739	537	590	297	253
1977	7,273	353	425	200	4,514	586	565	370	260
1976	7,224	408	527	202	4,306	562	621	339	259
1975	7,156	427	541	194	4,164	627	613	329	261
1974	6,955	404	472	192	3,976	742	594	354	221
1973	6,502	416	358	149	3,693	664	666	362	194

e = Estimate.

* Not comparable with previous years' data due to change in method for estimating capacity.

Source: Canadian Pulp & Paper Assn.

mill. Major expansions are also under study at the existing Cenibra (Celulose Nipo-Brasileira SA) and Riocell (Rio Grande Cia. de Celulose do Sul) eucalyptus mills.

COMPARATIVE PRODUCTION COSTS

The sharp rise of the U.S. dollar from 1980 to early 1985 and its even more dramatic fall through the end of 1987 caused significant shifts in comparative cost advantage among the major traditional market pulp producing regions of the world.

The U.S. South has again become the lowest-cost region for producing bleached softwood kraft market pulp, followed by the British Columbia interior, according to a recent study prepared for the Forest Sector Advisory Council, a Canadian government advisory group. Sweden and Finland—which were generally the lowest-cost traditional producing regions in 1983-85—have become the highest in cost due to their strong currencies (a position they also occupied in the late 1970s).

Delivered manufacturing costs (excluding depreciation and interest) in 1986 were estimated at $323/metric ton in the U.S. South, $327 in the British Columbia interior, $353 on the British Columbia coast, $359 in eastern Canada, and $373 in the U.S. West, according to a study prepared by Price Waterhouse. Finland was estimated to be at $404 and Sweden at $409. (All figures converted to U.S. dollars.)

As a result of the further weakening of the dollar, North American producers would have further increased their competitive position over Nordic producers in 1987. At early-1988 exchange rates—and assuming no cost inflation—delivered costs of Nordic producers would be equal to about $480 to $500/metric ton, based on the 1986 data contained in the study.

At first-quarter 1988 pulp price levels, this would suggest a profit margin of roughly 30% for Swedish and Finnish producers and a bonanza level approaching 50% for U.S. southern and interior British Columbia mills (excluding any interest and depreciation expenses). This would, of course, help make up for poor profitability suffered by North American producers during the first half of the 1980s.

Manufacturing costs in Sweden rose more rapidly than in

CANADIAN EXPORTS OF WOODPULP[1]

(000 metric tons)

	All grades[2]	Dissolving & special alpha	Sulfite bl.	Sulfite unbl.	Sulfate bleached hardwood	Sulfate bl. softwood	Sulfate semi-bl.	Sulfate unbl.	Mechanical
1986	7,838	216	388	48	529	5,447	346	137	346
1985	7,025	174	292	49	507	5,047	344	152	360
1984	7,040	182	313	61	519	4,930	349	156	379
1983	6,823	177	283	50	477	4,981	340	166	314
1982	6,099	174	295	101	359	4,375	290	230	272
1981	6,744	221	424	86	429	4,627	399	281	270
1980	7,248	235	396	108	409	5,095	484	210	311
1979	7,090	241	482	104	341	4,929	429	248	317
1978	6,638	210	509	83	350	4,562	390	243	291
1977	6,092	130	564	81	341	4,032	372	295	276
1976	6,116	147	515	92	341	4,074	399	262	286
1975	5,001	125	414	82	285	3,271	294	331	189
1974	6,438	243	532	141	306	4,117	456	373	262
1973	5,939	208	385	107	381	3,677	471	448	253
1972	5,536	283	369	100	411	3,244	494	377	249
1971	5,149	316	387	115	392	2,893	482	342	210
1970	5,063	302	440	162	345	2,753	467	328	251
1965	3,495	349	570	239	1,501		202	333	284
1960	2,360	220	394	154	889		127	314	213
1955	2,146	299	415	337	608[3]		n.a.	201	238
1950	1,675	263	243	374	356[3]		n.a.	172	225

n.a. = Not available.

[1] Includes some pulp shipped to mills in the U.S. that have the same ownership. Such "tied" pulp, which totals about 1.0 million tons, is not included in market pulp shipments.

[2] Total includes screenings (not shown). Years 1950-60 include small amounts of soda pulp (not shown).

[3] Includes semibleached sulfate.

Source: *Statistics Canada.*

CHEMICAL PAPER-GRADE MARKET PULP CAPACITY OF MAJOR NORTH AMERICAN PRODUCERS

	Annual capacity* (000 metric tons)			Capacity share (%)
	U.S.	Canada	Total	
1. Weyerhaeuser[1,2,3,5,6]	510	735	1,245	9.1%
2. Canadian Pacific Forest[1,2,3,4]	—	925a	925	6.8
3. International Paper[1,2,6]	800	—	800	5.8
4. Georgia-Pacific[1,2,5]	650	—	650	4.8
5. Canfor[1,3,4]	—	635	635	4.6
6. Parsons & Whittemore[1,2]	385	230	615	4.5
7. Repap Enterprises[1,3,4]	—	510	510	3.7
8. Great Northern Nekoosa[1,2,3]	490	—	490	3.6
9. MacMillan Bloedel[1,3,4]	—	481	481	3.5
10. Fletcher Challenge[1,3,4]	—	466b	466	3.4
11. Champion International[1,2]	250	188c	438	3.2
12. Federal Paper Board[1,2]	406	—	406	3.0
13. B.C. Forest Products[1,3,4]	—	400	400	2.9
14. Noranda Forest[1,2,5]	—	390d	390d	2.9
15. ITT Rayonier[1,5,6**]	370	—	370	2.8
16. Western Forest[1,3,5,6]	—	355	355	2.6
17. Boise Cascade[1,3,4]	272	45	317	2.3
18. Donohue-St. Félicien[1]	—	290	290	2.1
19. Louisiana-Pacific[1,5,6]	290	—	290	2.1
20. Irving Forest[1]	—	280	280	2.0
21. Mead[1,6]	125	145	270e	1.9
22. Bowater[1,3]	240	—	240	1.8
23. Stone Container[1,2]	220	—	220	1.6
24. Procter & Gamble (Buckeye)[1,6**]	100	100	200	1.5
25. Celgar Pulp[1]	—	195f	195	1.4
26. Consolidated-Bathurst[1,2,4]	—	190	190	1.4
27. Crestbrook[1]	—	180	180	1.3
28. Domtar[1,2,3,4,5]	—	170	170	1.2
29. E.B. Eddy[1,2,4]	—	150	150	1.1
30. Port St. Joe[2]	145	—	145	1.0
31. Chesapeake[2]	145	—	145	1.0
32. Willamette Industries[2]	110	—	110	0.9
33. Waferboard[1]	—	110	110	0.9
34. Westvaco[1,2]	95	—	95	0.7
35. Scott Paper[1]	—	90	90	0.7
36. Temple-Eastex[1]	70	—	70	0.6

North American capacity (1988): 13.677 million metric tons
Capacity share of top five companies: 31.1%
Capacity share of top ten companies: 49.8%

Key to grades: 1—bleached softwood kraft; 2—bleached hardwood kraft; 3—semibleached softwood kraft; 4—unbleached softwood kraft; 5—bleached sulfite; 6—fluff pulp.

* Capacity share based on equity ownership (excluding less than 50%-owned affiliates, which in many cases appear as separate listings).

** Exact capacity difficult to estimate because company has some mills which also make dissolving pulp or because company is highly integrated.

a. Reflects consolidation of Great Lakes Forest Products (595,000 tpy) and CIP (330,000) into Canadian Pacific Forest Products.

b. Reflects 100% of Crown Forest (190,000 tpy) and 69% of British Columbia Forest Products (400,000).

c. Includes 84.6% of Weldwood Canada, which has a 50% interest in Cariboo Pulp & Paper (279,000 tpy).

d. Includes Fraser (115,000 tpy) and Maclaren Industries (130,000 tpy) and 50% of Northwood Pulp & Timber (290,000 tpy). MacMillan Bloedel (48% owned) shown separately.

e. Includes Northwood Pulp and Brunswick Pulp & Paper.

f. Owned 25% by Consolidated-Bathurst, 25% by Power Corp., and 50% by a Chinese government agency.

any other region, up 18.2% from 1983 to 1986, according to a study called "The Market Pulp Industry 1983-86." The main area where Swedish costs rose more rapidly than elsewhere was for fiber, which jumped 32% over the four-year period, reflecting a tax system that does not provide much incentive for timber harvesting by private woodlot owners, the study noted.

Overall costs per ton rose 4.2% in eastern Canada over the same period and 2.4% in Finland, and they actually declined in British Columbia and the U.S. regions—helped by rising mill utilization rates which reduced fixed costs per ton. Fiber costs in British Columbia continued to be the lowest for all regions. In North America for 1986, fiber costs per average daily ton ranged from 35% (in the British Columbia interior) to 50% (eastern Canada) of mill level costs. In Sweden and Finland, however, fiber costs were 67% and 74%, respectively, of mill level costs.

The drop in oil prices benefited the regions which use the most fuel oil. The cost of purchased fuel dropped by about $14/daily ton on the British Columbia coast, by $15 in the U.S. South, and by $10 in the West. Nordic mills benefited least since they have less than half the purchased energy costs of mills in other regions, mainly due to cogeneration. (Finland generated all of its electricity needs in 1986, while the South generated 77% and Sweden 70%.)

In 1986, Finland's labor costs were 35% lower than those of North American mills because of high productivity (two hours labor/daily ton—the lowest for any region) and lower wage rates. The practice of contracting out for various services reduced labor costs in the U.S. and Sweden but increased costs for various other materials and services.

The U.S. South in 1986 still had the largest and newest mills—with an average size of 1,175 tpd and age of six years since the last major rebuild. The Swedish industry ranked second in size and modernity. British Columbia coastal mills still had the oldest machines and lowest average capacity per line—although average age (17 years) and efficiency improved due to a major modernization at one mill.

Property taxes in British Columbia are still higher than in other regions, although they were reduced in recent years. Delivery costs continue to be highest for British Columbia interior mills, reflecting inland freight for ocean shipping and longer distances from major markets.

Among major hardwood producing countries, Brazil probably still has the lowest manufacturing cost, followed by Portugal and the U.S. South. The Nordic countries have the highest production costs. Aracruz of Brazil, one of the most efficient hardwood pulp mills, estimated its direct manufacturing costs in 1987 at $197/ton. If depreciation and interest are included, Brazil would lose some of its

OPERATING RATES FOR NORTH AMERICAN AND SCANDINAVIAN PAPER-GRADE MARKET PULP MILLS

Year	U.S.	Canada	Sweden	Finland	Norway	Total
1987	101%	98%	88%	96%	101%	97%
1986	95	92	84	89	91	91
1985	86	86	81	84	89	86
1984	94	86	93	90	94	89
1983	89	88	87	82	90	85
1982	85	77	68	72	86	77
1981	90	89	79	89	83	97
1980	95	99	90	95	84	93
1979	88	93	82	94	n.a.	90
1978	92	83	70	71	n.a.	80
1977	87	80	62	58	n.a.	74

n.a. = Not available.

Source: Trade associations.

CHEMICAL PAPER-GRADE PULP SHIPMENTS BY NORTH AMERICAN AND SCANDINAVIAN PRODUCERS

(000 metric tons)

Year	U.S.	Canada	Sweden	Finland	Norway	Total	Brazil
1987	6,236	7,260	2,864	1,764	342	18,465	1,359
1986	5,912	6,674	2,803	1,603	326	17,407	1,216
1985	5,183	6,058	3,036	1,632	299	16,208	1,256
1984	4,970	5,854	3,351	1,680	304	16,475	1,298
1983	4,816	6,219	3,122	1,743	202	16,102	1,259
1982	4,172	5,131	2,487	1,565	120	13,475	1,100
1981	4,248	6,024	2,816	1,839	134	15,061	1,060
1980	4,342	6,481	2,877	2,057	75	15,832	1,184
1979	3,781	6,078	3,335	2,030	112	15,336	765
1978	3,378	5,953	3,714	1,687	129	14,861	212
1977	3,030	5,327	3,167	1,304	172	13,000	55

Source: North American and Nordic trade associations.

advantage due to the high capital costs of its new mills.

Capital costs for building new chemical market pulp mills have gone up dramatically over the past 20 years.

The cost for Leaf River Forest Products' 1,000-tpd bleached kraft mill at New Augusta, Miss., which began running in the fall of 1984, was about $530,000/daily metric ton. This compares to a cost of around $315,000/ton to build the 1,000-tpd Alabama River Pulp Co. mill at Claiborne, Ala., in 1978, and $110,000 for the original Northwood Pulp & Timber Ltd. mill in British Columbia, completed in 1966.

Cost of building new greenfield mills in tropical countries may run significantly higher. Aracruz, completed in the late 1970s, had an original capacity of around 400,000 and cost more than $600 million for an average cost of about $530,000.

MECHANICAL PULPS

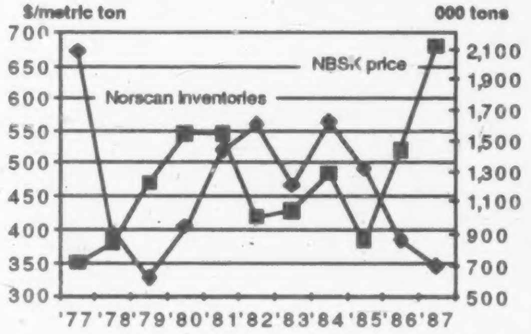
Mechanical pulps are produced by either the groundwood, refiner mechanical, or thermomechanical pulping processes. A newer process is chemi-thermomechanical pulping (CTMP), which seems to be replacing the earlier processes for producing mechanical market pulp.

Three new bleached chemi-thermomechanical (BCTMP) market pulp mills in Canada and the expansion of another are expected to add more than 600,000 tons of BCTMP capacity over the next two years. These installations include Cascades Inc.'s 180,000-tpy conversion of the former Port-Cartier, Que., dissolving pulp mill; Millar Western Industries Ltd.'s new 210,000-tpy mill at Whitecourt, Alta.; and Fibreco Export Inc.'s new 180,000-tpy mill at Taylor, B.C. In addition, Quesnel River Pulp Co. is expanding its existing mill in British Columbia—the first and still the largest such mill in North America—by 100,000 tpy.

Because of the timing of the startups, only slightly more than 200,000 tons of the total will be available for sale in 1988. This tonnage will be added to existing output from Tembec Inc.'s new 100,000-tpy Temiscaming, Que., mill, which started up in 1986, and Consolidated-Bathurst Inc.'s Bathurst, N.B., mill. Originally designed to supply the company's Bridgewater, U.K., newsprint mill, Con-Bath plans to sell some of the output on the open market.

At the same time, some earlier mechanical market pulp

RELATIONSHIP OF NORSCAN PRODUCER PULP INVENTORIES AND THE PRICE OF NORTHERN BLEACHED SOFTWOOD KRAFT DELIVERED IN NORTHERN EUROPE



NORTH AMERICAN & SCANDINAVIAN CHEMICAL PAPER-GRADE PULP SHIPMENTS BY MAJOR WORLD MARKETS

(000 metric tons)

Year	U.S.	Western Europe[1]	Japan	Nordic countries	To other countries	Total
1987	4,970	6,660	1,755	1,088	3,992	18,465
1986	4,831	6,563	1,618	1,018	3,349	17,407
1985	4,466	6,157	1,353	933	3,299	16,208
1984	4,682	6,181	1,241	969	2,975	16,408
1983	4,603	6,457	1,207	951	3,201	16,102
1982	3,811	5,551	980	773	2,360	13,475
1981	4,197	6,409	947	897	2,611	15,061
1980	4,327	6,536	1,244	991	2,734	15,832
1979	4,493	6,587	1,017	993	2,246	15,336
1978	4,193	6,520	973	878	2,297	14,861
1977	3,838	5,653	689	733	2,087	13,000

1. Including U.K.

Source: North American and Nordic trade associations.

mills are being integrated. Repap Enterprises Corp.'s 130,000-tpy stone groundwood mill (Acadia) in New Brunswick is expected to have only about 20,000 to 30,000 tpy available for market once a second coated paper machine is installed at the adjacent Miramichi mill in 1990. And the 150,000 tpy Finlay Forest Industries Ltd. refiner mechanical market pulp mill at Mackenzie, B.C., is being integrated by British Columbia Forest Products Ltd. with a new newsprint machine.

Additional expansion projects in New Zealand, Brazil, Sweden, and Mexico could add roughly another 250,000 tons of capacity over the next two years. This expansion would be on top of existing world market CTMP capacity, which was estimated at close to one million tons in 1987. As a result of rapid expansion, market BCTMP is expected to grow from about 4% of total world bleached market pulp supply last year to about 6% of supply in 1988.

More new BCTMP projects may be announced. Donohue Inc. and Rexfor, the Quebec government forestry agency, recently revealed plans for a new C$288-million mill with a capacity of 190,000-metric-tpy at Matane, Que. Startup would be in 1990 if financial assistance can be arranged with the federal and provincial governments. And Louisiana-Pacific Corp. is studying a proposed new BCTMP mill in British Columbia.

The main attractions of CTMP investment are reduced capital cost and much lower wood consumption. A new greenfield bleached CTMP mill can be built for less than one half the cost of a new kraft market pulp mill (on a per-daily ton basis), and a ton of CTMP can be produced with less than half the wood required to make a ton of bleached softwood kraft pulp. Because of its lower manufacturing cost, CTMP can be sold at 75% to 80% of the price of northern bleached softwood kraft pulp.

More controversial are the quality characteristics and future markets for BCTMP market pulp. Although lower than kraft pulp in tensile and tear strength, CTMP is superior in regard to bulk, opacity, and absorbency, Lennart Nellbeck, managing director, Rottneros Bruk AB of Sweden, said recently. A major disadvantage of mechanical pulps is lower brightness and brightness reversion.

U.S. CONSUMERS' PURCHASED PAPER GRADE PULP INVENTORIES

(000 metric tons)

	1987		1986		1985	
	Tons	Days	Tons	Days	Tons	Days
Jan.	428	30	408	32	521	39
Feb.	454	32	430	33	533	39
Mar.	464	32	448	33	536	41
Apr.	469	32	437	32	497	38
May	461	32	413	30	493	39
June	480	34	462	33	490	38
July	493	35	471	34	459	35
Aug.	489	34	441	32	455	34
Sept.	509	35	453	33	451	34
Oct.	48[illegible]	32	429	31	472	36
Nov.	453	n.a.	438	30	441	35
Dec.	480	n.a.	450	31	484	38

Note: Days of consumption based on average monthly market pulp shipments to the U.S. for the current and previous two months.

Source: American Paper Institute.

NORTH AMERICAN AND SCANDINAVIAN PRODUCER INVENTORIES OF CHEMICAL PAPER-GRADE MARKET PULP

(000 metric tons)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1987	992	1,035	867	913	936	795	960	1,049	856	875	911	691
1986	1,327	1,331	1,133	1,025	1,077	960	1,041	1,052	920	902	1,035	870
1985	1,781	1,882	1,800	1,589	1,466	1,472	1,513	1,552	1,393	1,511	1,554	1,329
1984	1,289	1,059	914	997	1,028	1,040	1,038	1,234	1,309	1,494	1,629	1,619
1983	1,698	1,746	1,570	1,531	1,523	1,435	1,599	1,624	1,475	1,503	1,630	1,207
1982	1,579	1,690	1,767	1,744	1,840	1,878	1,876	1,923	1,748	1,840	1,809	1,603
1981	1,097	1,194	1,209	1,193	1,185	1,026	1,116	1,195	1,146	1,373	1,573	1,430
1980	745	741	747	754	801	745	813	916	830	933	1,094	949
1979	938	1,006	960	865	809	737	759	790	734	713	723	616
1978	2,119	2,016	1,857	1,776	1,612	1,288	1,188	1,193	1,069	1,046	1,038	903
1977	2,891	2,920	2,888	2,760	2,810	2,789	2,822	2,865	2,776	2,656	2,577	2,083
1976	2,121	2,260	2,373	2,408	2,474	2,588	2,638	2,749	2,720	2,809	2,882	2,824
1975	860	1,016	1,326	1,464	1,754	1,858	1,980	2,101	2,049	2,091	2,163	2,013
1974	628	628	625	595	565	532	545	557	538	550	567	611

Source: North American and Nordic trade associations.

However, aspen CTMP can be bleached to ISO 85 and spruce to ISO 80 to 81, which is adequate for many grades of paper and paperboard, he noted.

So far, the main market end use for CTMP appears to be in tissue (particularly for towels and napkins), bleached board, and fluff pulp. In North America, Quesnel River Pulp Co. is reportedly a major supplier to Procter & Gamble Co.'s tissue mills, while Millar Western Pulp Ltd. is said to have a contract to supply about half of its future output to Scott.

The biggest potential market for low-freeness CTMP is in printing/writing grades, but BCTMP may have difficulty achieving acceptance in wood-free grades because of present industry standards limiting mechanical pulp content to 10%. Market BCTMP may find easier acceptance in wood-containing papers such as coated groundwood, uncoated groundwood, and newsprint. Many of the mills, however, are integrated for their mechanical pulp requirements and need chemical market pulp to add strength.

Nevertheless, the current tightness in pulp supply should help BCTMP find various niches as papermakers try to blend it into their furnishes. API's Ronald J. Slinn said recently that BCTMP is unlikely to become as popular as eucalyptus—a low-cost pulp introduced ten years ago that was found to actually enhance paper performance and machine productivity. Rather, BCTMP is likely to be used as an extender pulp which will tend to displace hardwood chemical grades in many applications, he noted. "It will be interesting to observe as both the art and science of papermaking respond to this unusual market pulp challenge," he said. "Necessity may well be the mother of invention." If markets do not develop, some of the new BCTMP mills will eventually be integrated with paper machines.

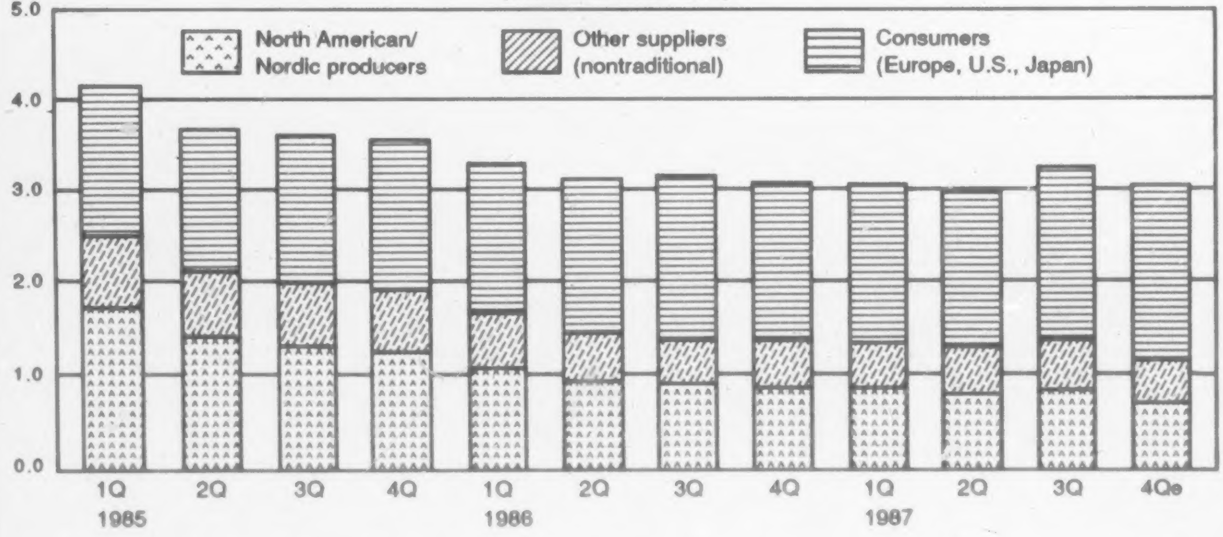
NONPAPER PULPS

Dissolving pulps, also referred to as chemical cellulose, are highly purified grades of market pulp, composed of 95% to 99% cellulose. These pulps are used to produce man-made fibers (rayon and acetate), films (cellophane), plastics (cellulose acetates), and chemicals (methyl cellulose and carboxylmethyl cellulose). Two processes are used for producing dissolving pulps, mainly from softwood, although some hardwood is used: (1) the prehydrolyzed sulfate process, and (2) the modified acid sulfite process. By these processes, a number of grades of varying quality can be made, each suitable for different end uses.

The quality of a dissolving pulp grade for a particular process depends on its purity and reactivity for a given process. For example, sulfite dissolving pulps are generally considered to be the most reactive pulps and are suitable for producing rayon and cellophane made under lenient rayon (viscose) processing conditions. Prehydrolyzed sulfate pulps generally produce a stronger rayon fiber for such uses as high-wet-modulus textile rayon and for high-tenacity rayon tire cords. Cotton linter is also used to produce cellulose acetates and cellulose plastics, but it is rarely used for producing rayon fibers.

Chemical cellulose products can be divided into four

COMBINED WORLD PRODUCER AND CONSUMER INVENTORIES OF CHEMICAL PAPER-GRADE MARKET PULP, QUARTERLY, 1985-87
(millions of metric tons)



Source: Canadian Pulp & Paper Assn.

e = Estimate.

groups based on the processes—viscose, acetate, ethers, and nitration—used to convert them: (1) Viscose products are the largest group and consume about 80% of dissolving pulp shipped. About 75% of viscose production consists of rayon for textiles and tire cord, with the remainder going into cellophane and such products as sausage casings and sponges; (2) acetate products are the second largest group and include textiles, cigarette filters, rigid packaging, photographic film, and high-quality plastics; (3) cellulose ethers are finding increased use in pharmaceuticals, cosmetics, detergents, food products, superabsorbents, and additives for oil-well drilling muds; (4) cellulose nitrates are used in explosives, lacquers, printing inks, and rocket fuels.

Dissolving pulp producers in recent years have been hurt by sharp cost escalations for wood and energy, plus the growing acceptance of lower-cost synthetic fibers and films. Rayon staple, for example, is under heavy competitive pressure from polyester, while plastic films such as oriented polypropylene are displacing cellophane.

This development is reflected in U.S. dissolving pulp production, which declined from a peak of around 1.6 million metric tons in the mid-1970s to a low of 988,000 tons in the 1982 recession, before recovering to 1.2 million metric tons in 1987. Canadian dissolving pulp production followed a similar trend, declining from a peak of 450,000 tons in 1969 to 243,000 tons in 1987. ITT Rayonier shut down a troubled 260,000-tpy sulfite dissolving and paper-grade pulp mill at Port-Cartier, Que., in 1979, and CIP Inc. closed its older, 91,000-tpy Hawkesbury, Ont., sulfite dissolving pulp mill at the end of 1982. In addition, about 400,000 tons of capacity at eight mills in western Europe were either shut down or converted to other grades during the 1981-85 period.

Even with the capacity shutdowns, dissolving pulp remained in oversupply during the first half of the 1980s. Prices for 91 to 92 alpha viscose rayon staple grades dropped to a low of about $500/metric ton in the U.S. during the 1985 market downturn. Prices fell below $400 in some southeast Asian markets due to strong competition from Saiccor (Pty) Ltd., a highly efficient South African mill owned by Courtaulds Ltd. This put heavy financial pressure on most Pacific Coast dissolving sulfite pulp mills. Alaska Pulp Co., a Japanese-owned mill at Sitka, ran up losses totaling more than $100 million during this period. Higher-alpha pulps used for acetate and other specialties held up better during the market downturn due to fewer producers (a few southern mills using the prehydrolized kraft process) and more specialized markets.

WORLD CHEMICAL PAPER-GRADE MARKET PULP CAPACITY, POTENTIAL PRODUCTION, AND DEMAND FORECAST[1]

(000 metric tons)

	1984		1985		1986		1987	1988	1989
CAPACITY	Capacity	Actual production	Capacity	Actual production	Capacity	Actual production	Capacity	Capacity	Capacity
Total world[2]	24,850	23,180	25,605	23,250	25,575	24,500	26,700	26,950	27,240
DEMAND (shipments)	Actual		Actual		Actual		Estimated	Estimated	Estimated
Canada	890		840		880		980	1,005	1,005
U.S.	4,840		4,710		5,130		5,145	5,165	5,200
Nordic countries	1,005		1,000		1,130		1,170	1,145	1,125
Western Europe	9,275		9,445		10,315		10,475	10,650	10,675
Eastern Europe	230		205		285		285	295	300
Latin America	1,280		1,620		1,705		1,765	1,825	1,910
Japan	2,290		2,400		2,595		2,700	2,770	2,825
Oceania	245		225		280		320	280	305
Asia,[3] Africa	2,520		3,015		2,865		3,000	3,025	3,050
Total	22,575		23,460		25,185		25,840	26,160	26,395
RATIO									
Demand/capacity	91%		92%		95%		97%	95%	95%

1. Practical maximum capacity: 100% of capacity for Canada and Norway.
97% of capacity for Finland and Sweden.
95% of capacity for Latin America, U.S., western Europe.
90% of capacity for Japan and others.
2. Excluding eastern Europe and China.
3. Including China.

Source: North American and Nordic trade associations.

1987 PULP EXPORTS FROM MAJOR PRODUCING COUNTRIES

(000 tons)

Major Importers			**Exporter**			
EUROPE	U.S.	Canada	Sweden	Finland	Norway	Brazil
Austria	19	23	77	30	4	5
Belgium[1]	42	166	146	34	15	41
Czechoslovakia	0	—	22	35	13	—
Denmark	1	4	66	7	18	5
Finland	8	13	24	—	13	1
France	285	237	319	146	52	51
Germany, Dem. Rep.	—	5	9	26	—	6
Germany, Fed. Rep.	569	605	652	393	73	72
Greece	28	19	23	31	—	—
Hungary	0	—	26	7	1	—
Italy	328	422	358	113	43	37
Netherlands	117	153	193	60	56	20
Norway	—	—	72	5	—	—
Poland	4	—	23	15	22	—
Portugal	5	1	4	7	3	—
Romania	5	3	—	—	—	1
Spain	80	52	72	19	—	7
Sweden	3	18	—	19	41	11
Switzerland	28	42	67	45	4	8
U.K.	261	397	302	243	70	57
U.S.S.R.	13	32	1	103	61	—
Yugoslavia	6	7	17	2	—	2
Other	5	11	30	7	13	—
Total Europe	1,808	2,210	2,503	1,347	502	324
NORTH AMERICA						
Canada	130	—	2	—	—	7
U.S.	—	3,760	57	18	—	270
Total North America	130	3,760	59	18	—	277
ASIA/AUSTRALASIA						
Australia	17	105	25	37	1	3
China	124	223	69	54	8	16
Hong Kong	9	42	—	—	—	—
India	49	78	30	9	2	1
Indonesia	83	94	25	9	—	—
Iran	—	1	2	1	—	—
Iraq	9	1	—	—	—	—
Israel	34	12	14	19	3	—
Japan	914	1,130	94	47	—	201
Korea, Rep.	353	176	23	25	—	8
Taiwan	151	123	29	11	—	7
Thailand	11	37	8	1	—	—
Turkey	21	7	34	12	—	—
Other	72	41	52	20	20	3
Total Asia/Australasia	1,847	2,070	405	245	34	239
LATIN AMERICA						
Argentina	10	12	—	—	—	14
Colombia	7	3	—	0	—	10
Mexico	321	55	—	—	—	8
Venezuela	167	94	—	0	—	10
Other	46	14	1	0	—	11
Total Latin America	551	178	1	0	—	53
AFRICA						
Algeria	8	—	11	15	—	—
Egypt	21	4	5	4	—	2
Morocco	—	—	15	5	—	—
South Africa	2	16	—	—	—	6
Other	—	4	31	7	8	—
Total Africa	32	24	62	31	8	8
WORLD TOTAL	4,368	8,242	3,030	1,641	544	899

[1] Total that entered through Belgian ports, not necessarily for Belgian mills.

Source: *Pulp & Paper International*, Annual Review, July 1988.

The sharp rise in paper-pulp prices led to a pickup in dissolving pulp prices beginning in depressed export markets and then spreading to the U.S. market in 1987. By the second quarter of 1988, the price of 91 to 92 alpha viscose had reached about $700/metric ton. Among acetate grades, 93 to 94 alpha was reported to be about $730 to $740, and 96.0 to 97.5 at about $750 to $760 in the U.S. Nevertheless, the lower-alpha dissolving pulps were still selling at about the same level as paper pulp even though they are more expensive to produce. Until the early 1980s, the lower-alpha dissolving pulps sold at roughly a $100/ton premium to paper-grade pulp. As a result, some dissolving pulp producers are producing more paper-grade pulp.

ITT Rayonier, the largest North American dissolving pulp producer, predicted that chemical cellulose products will grow at about a 1%/year rate. On a tonnage basis, most of this growth is expected to be in regular rayon staple, in demand principally from Asia. Demand from eastern Europe also recently picked up due to some rumored capacity curtailments. The fastest percentage growth is expected to be in high-performance rayons (such as high-wet-modulus staple which offers cotton-like quality and high durability) and in cellulose ethers and nontextile acetate uses such as cigarette filters. Other cellulose acetate markets are seen as fairly stable, with the exception of cellophane, which is expected to continue to decline.

Some efforts are also being made to improve the viscose process, which is highly capital- and energy-intensive and involves toxic and flammable chemicals. In the process, cellulose is treated with caustic soda and carbon disulfide to form cellulose xanthate, which is then dissolved in a weak caustic solution to form the viscose used to spin rayon staple. Major U.S. rayon producers include BASF Fibers Div., Avtex Fibers, and Courtaulds North America Co.

About 21% of world dissolving pulp capacity of 6.23 million metric tons in 1985 was in the U.S. and another 5.3% in Canada, according to the Food & Agriculture Organization of the United Nations. The Scandinavian countries account for 12% of total capacity, the rest of western Europe for 7.7%, Japan for 7%, eastern Europe for 8%, and the Soviet Union for 27%. The most important markets are western Europe (which accounts for about half

MAJOR CHEMICAL PAPER-GRADE MARKET PULP PRODUCERS OUTSIDE NORTH AMERICA

Company	**Country (mills)**	**Estimated capacity (000 metric tpy)**
Södra Skogsägarna[1,2,3]	Sweden (Mörrum, Mönsterås, Väro)	849
Portucel[2,4,5]	Portugal (Cacia, Ródão, Setubal,	736
ENCE[1,2,5]	Spain (Huelva, Mirando del Ebro, Pontevedra)	550
Stora[1,2,4]	Sweden (Grums, Sandarne, Skutskär)	485
Aracruz[2]	Brazil (Aracruz)	476
Mo och Domsjö[1,2,4,6]	Sweden (Domsjö, Husum)	460
Veitsiluoto[1,2]	Finland (Kemi, Kemijärvi, Oulu)	435
Cel. du Rhône et d'Aquitaine[1,2]	France (Saint-Gaudens, Tarascon)	409
Cel. Arauco y Constitución[1,4]	Chile (Arauco)	385
Cenibra[2]	Brazil (Belo Oriente)	355
Soporcel[2]	Portugal (Lavos)	330
Schauman[1,2,4]	Finland (Jacobstad)	286
SCA[1,2]	Sweden (Ostrand)	270
Jari[1,6]	Brazil (Jari)	234
Tofte Industrier[1,3]	Norway (Tofte)	228
Sanyo-Kokusaku[1,2,6]	Japan (Tokyo)	220
Riocell[2,5]	Brazil (Guaiba)	212
Alto Parana[1,4]	Argentina (Misiones)	212
Celbi[2]	Portugal (Leirosa)	208
Metsä-Botnia[1]	Sweden (Äänekoski)	205
Chung Hwa Pulp[1,2]	Taiwan (Chi-An)	192
Cel. des Ardennes[2]	Belgium (Harnoncourt)	185
Usutu Pulp[4]	Swaziland (Bhunya)	180

Key to grades: 1 = bleached softwood kraft; 2 = bleached hardwood kraft; 3 = semibleached softwood kraft; 4 = unbleached softwood kraft; 5 = unbleached hardwood kraft; 6 = bleached softwood sulfite.

Source: *Pulp & Paper International*, Market Pulp Survey, June 1987.

WORLD CHEMICAL PAPER GRADE MARKET PULP CAPACITY*

(000 metric tons)

Year	Total World	Canada	U.S.	Nordic	Sweden	Finland	Norway	Total Norscan
1989e	27,240	7,280	6,400	5,035	—	—	—	18,715
1988e	26,950	7,330	6,350	5,140	—	—	—	18,820
1987	26,700	7,265	6,150	5,305	—	—	—	18,720
1986	26,485	7,150	6,050	5,430	—	—	—	18,360
1985	25,605	6,930	5,600	5,475	—	—	—	18,005
1984	25,280	7,095	5,130	—	3,455	1,825	310	17,815
1983	24,880	7,020	5,085	—	3,455	1,990	220	17,770
1982	24,680	6,810	4,940	—	3,595	2,150	220	17,715
1981	24,545	6,810	4,990	—	3,830	2,160	140	17,840

Year	Austria	Benelux	France	Fed. Rep. Germany	Portugal	Spain	Switzerland	Total western Europe
1989e	415	235	975	80	1,260	735	130	3,830
1988e	415	235	935	80	1,145	730	130	3,670
1987	415	235	890	85	1,130	720	130	3,605
1986	415	225	850	105	1,130	655	130	3,510
1985	385	215	775	90	1,015	620	120	3,220
1984	315	240	770	105	950	570	115	3,065
1983	315	240	750	105	770	570	115	2,865
1982	290	240	680	105	735	520	110	2,715
1981	290	205	595	140	705	520	110	2,565

Year	Argentina	Brazil	Chile	Mexico	Total Latin America	Australia	New Zealand	Total Oceania
1989e	270	1,590	650	200	2,660	35	245	280
1988e	215	1,465	570	200	2,450	35	245	280
1987	215	1,435	530	200	2,380	50	245	295
1986	215	1,415	505	200	2,335	50	245	295
1985	235	1,405	485	195	2,320	25	260	285
1984	155	1,590	465	n.a.	2,210	15	320	335
1983	140	1,530	490	n.a.	2,160	5	320	325
1982	10	1,460	465	n.a.	1,935	5	335	360
1981	10	1,470	450	n.a.	1,930	5	335	360

Year	Japan	Indonesia	Rep. Korea	Taiwan	Morocco	South Africa	Swaziland	Total Asia/ Africa
1989e	780	75	145	310	95	175	175	975
1988e	780	65	145	295	95	175	175	950
1987	780	65	145	265	95	175	175	920
1986	810	65	145	265	95	160	175	905
1985	860	45	120	315	90	190	155	1,775
1984	1,035	25	105	310	95	100	170	1,855
1983	1,035	n.a.	105	305	95	40	170	1,760
1982	1,070	n.a.	105	330	95	55	175	1,955
1981	1,070	n.a.	90	260	95	55	175	1,850

* Practical maximum capacity.
e = Estimate.
n.a. = Not available.

Source: North American and Nordic trade associations.

of total consumption), North America, and Japan. Through 1989, world capacity is expected to remain relatively flat at 6.26 million tons.

Fluff pulp is produced mainly in roll form and shipped to sanitary disposable products manufacturers, who then disintegrate the thick pulp sheets into individual fibers to provide their products with bulk, softness, and high absorbency. The main use is in baby diapers, which account for 80% of U.S. fluff pulp consumption, but other uses include adult incontinence products, tampons, sanitary napkins, underpads, and wipes.

Fluff pulp is made mainly from bleached softwood kraft (chiefly southern pine) and is similar to paper-grade pulp. It is somewhat more expensive to produce than other pulps due to special sheet properties (which may include treatment with debonders) and packaging. Several North American sulfite mills are trying to increase fluff pulp production, although southern kraft appears to be favored for most applications because of its high absorbency. While mechanical fluff pulp production is growing in Europe and two new Canadian BCTMP mills are targeting the fluff market, its acceptance in the U.S. market is uncertain.

MAJOR WORLD CHEMICAL PAPER-GRADE MARKET PULP EXPANSIONS

North America	Location	Capacity (000 metric tpy)	Startup date
Repap	Prince Rupert, B.C.	55 BSK	1988
Weldwood	Hinton, Alta.	214 BSK**	1989
GN Nekoosa	Ashdown, Ark.	90 BSK	1989
ITT Rayonier	Jesup, Ga.	50 BSK	1989
Weldwood/Cariboo	Quesnel River, B.C.	55 BSK	1989
Louisiana-Pacific	Samoa, Calif.	32 BSK	1990
Weyerhaeuser	Columbus, Miss.	430 BS/HK**	1990
Howe Sound	Port Mellon, B.C.	125 BSK	1990
BCFP	Crofton, B.C.	45 BSK	1991
Daishowa Canada	Peace River, Alta.	340 BHK	1991
Europe			
Schauman	Jacobstad, Finland	65 BHK	1988
MoDo	Sweden (2 mills)	85 BS/HK	1988
Ence	Spain (3 mills)	130 BHK	1989
Portucel	Setubal, Portugal	110 BHK	1989
Alicel	Alizay, France	100 BHK	1989
Pohjan Sellu	Kajaani, Finland	400 BS/HK**	1991
Enso-Gutzeit*	Uimaharju, Finland	220 BHKP**	1991
Feldmûhle/or Spanish group*	Northern Spain	250 BKH**	1993
Latin America			
Aracruz	Espirito Santo, Brazil	525 BHK	1991
Cel. Puerto Piray	Misiones, Argentina	210 BS/HK	1990
Shell/Scott	Nacimiento, Chile	200 BHK	1991
Cel. Arauco	Arauco, Chile	265 BSK	1992
CMCP/Simpson	Nacimiento/Renaico, Chile	315 BHK	1992
Bahia Sul	Southern Bahia, Brazil	350 BHK	1992
Cenibra*	Minas Gerais, Brazil	350 BHK	1992-93
Copene*	Bahia, Brazil	340 BHK	1992-93
Riocell*	Rio Grande do Sul, Brazil	300 BHK	1994-95
Other regions			
Indorayon	Sumatra, Indonesia	160 BHK	1988
Indah Kiat	Riau, Indonesia	100 BHK**	1989
APPM*	Tasmania, Australia	400 BHK	1991
Donghae Pulp*	Rep. Korea	200 BHK	1991

* Proposed.

** Not all pulp would be for market.

BSK = bleached softwood kraft; BHK = bleached hardwood kraft; BS/HK = bleached softwood and hardwood kraft.

Fluff pulp demand is the fastest growing major end use for the U.S. market pulp industry, with consumption rising at a 7% to 8% average annual rate during the past decade. But in 1987, U.S. consumption probably declined, and domestic demand is projected to show relatively slow growth through the 1990s. The reasons for this include lower U.S. birthrates, the already high penetration of disposable diapers in the U.S., and the growing use of superabsorbent material in new thinner "ultra"-style baby diapers, which contain less fluff pulp.

According to a study prepared by Kenneth E. Lowe for Marketing/Technology Service Inc. of Kalamazoo, Mich., the population of infants in the U.S. aged 30 months and under will peak around 1990 and then decline during the next decade. Disposable diapers have already captured 78% of the U.S. market at the expense of cloth diapers and will probably increase their share to 90% by 2000. As a result, he projected disposable diapers in the U.S. will increase only from 17.8 billion units in 1987 to 20 billion units by 2000, an 11% increase.

At the same time, the growing use of superabsorbents is reducing the amount of fluff pulp required per diaper by about 30%. Superabsorbents have the capacity to absorb up to 50 times their weight in liquid and therefore permit the design of thinner baby diapers and less obtrusive adult incontinence products. Typically, about 5.0 g of superabsorbent material (usually polyacrylate powder or granules) is used per diaper. This results in a reduction in the weight of fluff pulp used in an average infant diaper from 50 g to 34.7 g.

Since their introduction less than two years ago, the new diapers containing superabsorbents have captured more than 50% of the U.S. diaper market and may have more than 90% by 1990, Lowe said. With the increasing use of

COMPARATIVE NORTH AMERICAN AND NORDIC REGIONAL MANUFACTURING COSTS FOR BLEACHED SOFTWOOD KRAFT MARKET PULP IN 1986

(US$/metric tpd)

	British Columbia		Canada	U.S.	U.S.		
	Coast	Interior	Eastern	West	South	Finland	Sweden
Wood fiber	$106	$91	$147	$114	$111	$267	$241
Chemicals	35	42	37	45	41	71	27
Energy	28	27	24	43	21	2	9
Labor	74	57	50	53	58	33	53
Other[1]	53	44	37	59	39	22	31
Mill level costs	296	261	295	314	270	361	360
Corporate and sales expense	14	11	14	9	10	14	14
Delivery	44	55	50	50	43	29	35
Total delivered cost[2]	353	327	359	373	323	404	409

HISTORICAL TOTAL DELIVERED MANUFACTURING COST FOR BLEACHED SOFTWOOD KRAFT AND COMPARATIVE RANKING AMONG REGIONS[2]

(Rank in parentheses)
(US$/metric tpd)

	British Columbia		Eastern	U.S.	U.S.		
	Coast	Interior	Canada	West	South	Finland	Sweden
1988[3]	$384 (4)	$356 (2)	$393 (5)	$393 (3)	$323 (1)	$500 (7)	$481 (6)
1986	353 (3)	327 (2)	359 (4)	373 (5)	323 (1)	404 (4)	409 (7)
1985	385 (7)	347 (3)	380 (6)	376 (5)	360 (1)	350 (2)	331 (4)
1984	425 (7)	397 (5)	380 (4)	384 (6)	385 (3)	344 (1)	316 (2)
1983	412 (7)	363 (3)	391 (5)	393 (6)	369 (2)	359 (1)	321 (4)

1. Includes materials, maintenance services and mill administration net of byproduct revenues.
2. Before depreciation and interest expense. (Depreciation costs in U.S. were $43 in West, $57 in South.)
3. *Pulp & Paper Week* estimate based on 1986 cost data at Feb. 5, 1988, exchange rates. Other years converted from currency of countries into U.S. dollars at average annual exchange rates.

Source: Forest Sector Advisory Council, "The Market Pulp Industry 1983-86."

superabsorbents, U.S. fluff pulp consumption for use in baby diapers has dropped from an estimated 811,000-ton peak in 1986 to 715,000 tons in 1987 and is forecast to decline to 691,000 tons by 1990 and 680,000 tons by 2000, according to Lowe. (Only estimates can be made of market size because fluff is included with paper-grade pulps for statistical purposes and some producers closely guard their capacity figures.)

This loss of fluff pulp demand for baby diapers is expected to be made up largely by improved demand for adult incontinence products. Adult incontinence products are expected to show strong growth due to an aging population and increased market penetration by disposables. Adult incontinence products currently consume about 121,000 tons of fluff pulp (about equally divided between retail and institutional markets), and demand is projected to roughly double to 252,000 tons by 2000.

U.S. DOMESTIC PRICES FOR BLEACHED KRAFT MARKET PULP

($/metric ton, delivered)

	Northern bleached softwood kraft	Southern bleached softwood kraft	Northern bleached hardwood kraft	Southern bleached hardwood kraft
1987				
4Q	$610	$585	$575	$565
3Q	575	550	540	530
2Q	575	550	540	530
1Q	550	520	510	500
1986				
4Q	480	490	470	460
3Q	480	450	425	420
2Q	450	420	385	380
1Q	410	360/385	340/360	320/345
1985				
4Q	400*	360	330/360*	320*
3Q	400/425*	375	350/380*	340*
2Q	425*	385	370/400*	360*
1Q	450*	425	400/410*	390*
Year-end				
1984	510*	475	460/470*	450*
1983	440	415/425*	410/420	390/400
1982	440	385*	364/380*	353*
1981	530/565	495	468/490*	424*
1980	530	507	490	480
1979	460	400	433	420
1978	375	353	342	330
1977	342*	287	276*	260*
1976	410	353	331	310
1975	410	353	369	353
1974	386	386	369	353
1973	259	246	248	213
1972	179	180	149	150
1971	165*	160	149*	148*
1970	188	180	171	170

* Indicates some discounting from price levels shown above.

As a result, overall total U.S. domestic demand for fluff pulp will remain nearly constant, rising from about 900,000 tons in 1987 to 982,000 tons by 2000, Lowe estimated. The share of fluff pulp consumed in baby diapers will decline from about 81% currently to 69% by 2000, while use in adult incontinence products will rise from 6% to 26%. Usage in feminine pads will remain relatively stable at 5% to 6%.

Stronger growth in export demand should help boost total U.S. fluff pulp production. U.S. fluff pulp production totaled an estimated 1.6 million tons in 1987, of which about 900,000 tons was consumed in the domestic market and about 740,000 tons was exported, Lowe estimated. North America supplies about 70% of total world fluff pulp demand. Fluff pulp demand should show stronger growth in Europe, Japan, and the less industrialized countries due to growing use of disposable diapers. The market share of disposable diapers in Japan is expected to grow from about 8% in the early 1980s to 34% in 1986, and could reach 64% by 1990, according to Uni-Charm Corp., a major Japanese diaper manufacturer. The strong disposable unit growth should more than offset increasing use of superabsorbents in Japan and Europe.

Total U.S. effective fluff pulp capacity is estimated at nearly 2.0 million tons. Major producers with capacity shares over 20% include Weyerhaeuser, Buckeye Cellulose

HISTORIC PRICES, 1950-69, FOR NORTH AMERICAN MARKET PULP

Average annual prices for bleached kraft pulp, delivered in U.S. domestic market (US$/short ton)

Year	Northern bleached softwood kraft	Southern bleached softwood kraft	Northern bleached hardwood kraft	Southern bleached hardwood kraft
1969	$145	$133	$131	$129
1968	145	123	118	115
1967	150	129	130	124
1966	148	135	136	129
1965	150	144	135	133
1964	146	141	128	130
1963	139	132	130	124
1962	143	129	134	124
1961	145	135	135	130
1960	156	151	151	146
1959	157	157	152	152
1958	157	157	152	152
1957	153	155	151	150
1956	151	154	149	149
1955	146	149	144	144
1954	142	145	140	140
1953	142	145	140	140
1952	142	145	—	—
1951	139	—	—	—
1950	120	—	—	—

Corp., and International Paper Co. Next largest are ITT Rayonier at around 14% and Kimberly-Clark Corp. at close to 9%, according to M/TS. Other smaller producers include Georgia-Pacific Corp., Brunswick Pulp & Paper Co., Tembec Inc., Western Forest Products Ltd., and Temple-Eastex Inc. Weyerhaeuser is believed to be the largest open market seller of fluff pulp, while P&G and K-C mainly consume it for captive use.

Total world effective fluff pulp capacity is estimated by the M/TS study at 2.8 million metric tons, of which 835,000 tons is outside North America. Most of this capacity is in western Europe and includes about 195,000 tons of BCTMP/thermomechanical pulp. Major European players include Stora Kopparbergs, Cellulose du Pin, Kornäs-Marma AB, and Metsä-Serla.

The slower growth in U.S. fluff pulp demand appears to have placed some mild pressure on fluff pulp pricing. Because it is more expensive to produce, fluff pulp normally sells at a premium to southern pine paper pulp. The second-quarter 1988 list price for untreated softwood kraft fluff pulp in rolls was $690 to $700/metric ton in the U.S. vs a list for southern pine paper pulp of $670. Prior to 1987, the differential was more like $50/ton. The second-quarter 1988 export list price to Europe was $735 to $745/metric ton c.i.f. The decline in domestic fluff pulp demand may have caused some loss of business for the larger sellers of fluff pulp (Weyerhaeuser, IP, and Rayonier), and it could force some smaller participants to drop out of the market (as Stone Container Corp. recently did at Panama City, Fla.). Nevertheless, any excess capacity will be easily absorbed because of the current strong demand for paper pulp.

Another major new development that could lead to further displacement of fluff pulp is the possible use of synthetic fibers in combination with fluff. The synthetic fiber that is being most widely experimented with is Hercules Inc.'s Pulpex (Type E 338), which is similar in length and morphology to woodpulp. At least two U.S. fluff pulp producers—Weyerhaeuser (at Plymouth, N.C.)

U.S. DOMESTIC PRICES FOR OTHER PAPER-GRADE MARKET PULPS

($/metric ton, delivered)

	Bleached sulfite	Unbleached softwood kraft	Bleached CTMP (75-80 GE bright)
1987			
4Q	$565/575	$545/575	$470/500
3Q	530/540	505/540	440
2Q	530/540	505/540	440
1Q	505	475/510	420
1986			
4Q	470	440/480	385
3Q	440	420/440	385
2Q	410	405	360
1Q	355	360	330
1985			
4Q	355	360	360
3Q	370	380	360
2Q	380	380	360
1Q	410	390	390
Year-end			
1984	455	430	415
1983	420/430*	370	365
1982	420*	360*	—
1981	520	490	—
1980	520	490	—
1979	450	422	—
1978	358	310	—
1977	320*	280*	—
1976	400	380	—
1975	400	380	—
1974	365	353	—
1973	255	225	—
1972	168	155	—
1971	160*	140*	—
1970	180	160	—

* Indicates some discounting from price levels shown.

U.S. DOMESTIC PRICES FOR SPECIALTY PULPS

($/metric ton, delivered)

	Fluff (untreated bl. softwood kraft in rolls)	Dissolving (sulfite viscose staple grade, 91-92 alpha)
1987		
4Q	$615	$615/635
3Q	580	580/600
2Q	580	540/560
1Q	560	550
1986		
4Q	540	510
3Q	500	510
2Q	475	500
1Q	440	500
1985		
4Q	440	500
3Q	440/460	505
2Q	460/475	510
1Q	493	515
Year-end		
1984	535/555	530
1983	470*	525
1932	485*	530
1981	572/607	620
1980	550	670
1979	475	530
1978	—	430
1977	—	455
1976	—	468
1975	—	425

* Indicates some discounting from price levels shown.

and Temple-Eastex (at Evadale, Texas)—are offering fluff blends containing about 15% to 20% polyethylene fibers. Such blends can be thermally bonded by the absorbent products converter using either through-air bonding or infrared heating equipment.

When heated to near its melting point, the plastic fibers bind all of the fibers in the pad. As a result, the pad maintains its shape better and does not collapse upon wetting. As a result of these advantages, absorbent products can be designed that are thinner, lighter, and stronger. However, the fluff pulp/polymer fiber blends are significantly more expensive (about $900/metric ton vs $560 for 100% southern pine fluff pulp). Reduction in core weights may compensate for the higher-priced material, particularly when superabsorbent is included. Already a few products using this new technology are starting to be marketed in Europe, the U.S., and Japan.

Another unusual new substitute for woodpulp fluff pulp is moss. Johnson & Johnson Inc. of Montreal and St. Raymond Paper Co. (1983) Inc. have formed a joint venture to produce a new absorbent material made from purified sphagnum moss at the latter's Desbiens, Que., sulfite pulp mill. The sphagnum material is said to offer twice the absorption capability of fluff pulp and will cost about 15¢/lb vs more than 25¢ for fully bleached fluff woodpulp. Production is scheduled to begin in early 1989. A process has been developed to bleach the moss, which has long been used by Eskimo tribes as an absorbent material.

NORTH AMERICAN EXPORT PRICES FOR BLEACHED KRAFT MARKET PULP

(US$/metric ton, c.i.f. northern Europe)

	Northern bleached softwood kraft	Southern bleached softwood kraft	Northern bleached hardwood kraft	Southern bleached hardwood kraft
1987				
4Q	$635	$610	$600	$595
3Q	610	585	575	570
2Q	585	560	550	545
1Q	550	525	515	510
1986				
4Q	520	490	475	470
3Q	480	460	445	440
2Q	450	420	395	390
1Q	415	380	350	345
1985				
4Q	380/390*	355*	330	325*
3Q	380/390*	355*	330	325*
2Q	380/390*	365*	340	335*
1Q	420*	390*	370	365*
Year-end				
1984	485*	465*	—	430*
1983	430*	400	—	385*
1982	420*	390*	—	360*
1981	545	500*	—	455*
1980	545	530	—	505
1979	465/475	450	—	435
1978	380	360	—	350
1977	350*	330/340*	—	300/320*
1976	415*	410*	—	405*
1975	415	410	—	405
1974	370	—	—	—
1973	232	—	—	—
1972	185	—	—	—
1971	185	—	—	—
1970	180	—	—	—

* Indicates some discounting from price levels shown.

NORDIC AND EUCALYPTUS PULP PRICES IN EUROPE

(Deutschemarks (DM) or US$/metric ton, c.i.f.)

	Northern bleached softwood kraft	Nordic birch	Bleached eucalyptus
1987			
4Q	DM1,180	DM1,130	DM1,075
3Q	DM1,125	DM1,075	DM1,075
2Q	DM1,125*	DM1,075	DM1,075
1Q	DM1,125*	DM1,075	DM1,075
1986			
4Q	DM1,100*	DM1,075	DM1,075
3Q	DM1,100*	DM1,025	DM1,025
2Q	DM1,080*	DM985	DM965/985
1Q	DM1,050*	DM910	DM900/$350
1985			
4Q	DM1,025*	DM875*	$330*
3Q	DM1,125	DM975*	$330*
2Q	DM1,200	DM1,075*	$340*
1Q	DM1,350	DM1,230*	$370*
Year-end			
1984	DM1,425*	DM1,325*	$435*
1983	$430*	$400	$390/400
1982	$420*	$390	$380*
1981	$545	$520	$480*
1980	$545	$520	$520
1979	$465/475	$450	$445
1978	$380	$360	$345
1977	$350	$325*	—
1976	$415	$405*	—
1975	$415	$405	—
1974	$370	$362	—
1973	$232	$220	—
1972	$185	$180	—
1971	$185	$180	—
1970	$180	$170	—

* Indicates discounting. List prices shown for 1986-87. Under price fixing settlements reached with the European Economic Community, Nordic producers increasingly began to make sales in local currencies in the second half of 1984.

MAJOR CHEMI-THERMOMECHANICAL MARKET PULP EXPANSIONS

North America	Mill location	Capacity (000 metric tpy)	Startup date
Cascades	Port Cartier, Que.	180	1988
Millar Western	Whitecourt, Alta.	210	1988
Quesnel River	Quesnel River, B.C.	80	1988
Fibreco	Taylor, B.C.	180	1988
Donohue Matane[1]	Matane, Que.	190	1990
International			
Caxton	Kawerau, N.Z.	80[2]	1988
Suzano/CVRD	Minas Gerais, Brazil	50	1988
Vaggeryds	Vaggeryd, Sweden	60	1989
Cel. y Papel de Durango[1]	Durango, Mexico	80	1989

1. Proposed.
2. Some output may be for integrated use.

The baby diaper business in the last few years has been marked by intense product development activity and shorter product cycles. About 80% of the U.S. diaper market is held by two companies: Procter & Gamble (with Pampers and Luvs holding about a 50% share) and Kimberly-Clark (with Huggies at slightly over 30%). The remainder is split among more than a dozen companies (the largest include J&J's Chicopee Div., Weyerhaeuser, Georgia-Pacific, Whitestone Products Corp., and Pope & Talbot Inc.), which may have increasing difficulty keeping up with the new high rate of product innovations. While most private-label producers were able to adopt "ultra" superabsorbent diaper technology, they may have more difficulty imitating the next round of designs from P&G and K-C, according to James P. Hanson, director of M/TS.

NORTH AMERICAN DISSOLVING PULP PRODUCERS ESTIMATED MILL CAPACITIES[1]

(000 metric tons)

Company	Prehydrolyzed sulfate pulp	Sulfite pulps	Cotton linters
ITT Rayonier			
Fernandina Beach, Fla.	—	150	—
Jesup, Ga.	450	—	—
Port Angeles, Wash.	—	155	—
Hoquiam, Wash.	—	—[2]	—
Buckeye Cellulose			
Foley, Fla.	—	180	—
Memphis, Tenn.	—	—	85
Alaska Lumber & Pulp			
Sitka, Alaska	—	190	—
International Paper			
Natchez, Miss.	250	—	—
Tembec Forest Products			
Temiscaming, Que.	—	160	—
Louisiana-Pacific			
Ketchikan, Alaska	—	125	—
Western Pulp			
Port Alice, B.C.	—	130	—
Weyerhaeuser			
Cosmopolis, Wash.	—	65	—
Hercules			
Hopewell, Va.	—	—	80
Alpha Cellulose			
Lumberton, N.C.	—	—	40
Southern Cellulose			
Chattanooga, Tenn.	—	—	30

1. Represents total pulp capacity. Not all of the capacity is used to make dissolving pulp.
2. Hoquiam mill has only been supplying slush pulp to adjacent Grays Harbor Paper Co. mill in recent years.

SHIPMENTS AND OPERATING RATES FOR NORSCAN DISSOLVING PULP MILLS

(000 metric tons; percent)

	U.S.		Canada		Nordic		Total	
	Tons	%	Tons	%	Tons	%	Tons	%
1987	1,213	95%	243	95%	291	n.a.	1,747	n.a.
1986	1,138	90	239	88	272	n.a.	1,649	n.a.
1985	1,036	81	216	84	349	83%	1,601	82%
1984	1,125	80	220	96	375	88	1,720	84
1983	1,112	83	210	108	397	69	1,719	82
1982	996	71	226	73	348	68	1,570	70
1981	1,217	86	270	91	432	68	1,919	82
1980	1,354	96	310	92	427	75	2,091	90
1979	1,375	97	371	93	527	78	2,273	91
1978	1,297	86	334	79	513	72	2,153	83

n.a. = Not available.

Source: American Paper Institute.

PLANNED DISSOLVING PULP TOTAL CAPACITY

(000 metric tons)

	1985	%	1990	%	% change
U.S.	1,309	21.0%	1,298	20.7%	0.8%
Canada	266	4.3	266	4.3	0.0
Japan	449	7.2	314	5.0	30.1
Finland	255	4.1	235	3.8	7.8
Norway	170	2.7	170	2.7	0.0
Sweden	325	5.2	270	4.3	16.1
South Africa	412	6.6	420	6.7	1.9
U.S.S.R	1,700	27.3	1,700	27.2	0.0
Asia[1]	270	4.3	507	8.1	87.7
Western Europe[2]	480	7.7	483	7.7	0.6
Eastern Europe[3]	519	8.3	519	8.3	0.0
Latin America	76	1.2	76	1.2	0.0
Total	6,231	100.0	6,258	100.0	0.4

1. Excludes Japan.
2. Exludes Nordic Countries.
3. Excludes U.S.S.R

Source: 1986 Food & Agriculture Organization capacity survey.

PULPING PROCESSES

Before paper can be made, papermakers must be furnished with a supply of fibers capable of producing a paper or board grade with desired strength properties and good runability on paper machines. The primary sources of fiber for papermaking are: (1) pulpwood, (2) wastepaper, (3) nonwood fibers, and (4) inorganic fibers. In the U.S. about 1% of the fiber supplied for paper and board making is from nonwood and inorganic fiber sources such as asbestos or bagasse. About 76% of the fiber supply is derived from pulpwood and 23% from wastepaper.

Pulping is the chemical or mechanical process of freeing fibers from wood. The goal of pulping is to disintegrate or separate wood fiber into its individual fibers without reducing fiber lengths or damaging strength properties. Pulping is accomplished in two ways: either by mechanical or chemical forces, or by a combination of the two. There are many different mechanical and chemical processes for pulping (or cooking) pulpwood. The pulping process chosen depends on one primary requirement: the grade of pulp required to make the strength requirements of a specific paper or board grade.

In mechanical pulping, mechanical energy through grinding or attrition is used to separate the fibers from one another. In chemical processes, strong chemicals and high temperatures are used to dissolve the binding material between the fibers, and once these binding materials (lignins) are partially removed or dissolved, the fibers will separate with a minimum of mechanical action, referred to as refining.

PULPWOOD SUPPLY

The pulpwood species used depends on the mill's location and the paper or board grades produced. In the U.S. South, principal species used are southern pine, mixed hardwood and oak. In the Pacific Northwest, the major species used are Douglas fir, hemlock, western pine and small amounts of western cedar, redwood and spruce. In the U.S. Midwest, the principal species are mixed hardwoods, oak and spruce. In the U.S. and Canadian Northeast, the major species used are eastern spruce, pine, balsam fir and mixed hardwood (poplar, white birch).

Because of increasing pressure on available softwood timber supplies, the percentage of hardwood used for producing pulp is expected to rise gradually. Hardwoods comprise about 40% of the commercial timber supply in the U.S. and about 21% of total timber volume in Canada. In the U.S., hardwoods have grown from only 10% of total pulp production in the mid-1940s to around 29% currently.

However, in Canada hardwoods have accounted for only about 8% of pulp produced in recent years—a situation that partly reflects the Canadian industry's concentration on bleached softwood kraft pulp and newsprint. Hardwood use is expected to grow in Canada, however, because of increased printing/writing paper production and expansion projects in Alberta based on hardwood.

Pulpwood is delivered to the pulp mill in either chip or log form. In the U.S. Pacific Northwest, about 65% to 70% of the pulpwood used is sawmill residue. The concept of using a tree for its greatest value—first using logs for lumber or plywood value and then using the residuals from the sawmills for either energy or pulpwood—has been practiced in the Northwest since the 1920s. Now this approach is increasingly being used in the U.S. South, where rotation cycles are being extended to yield more timber which can be processed into higher value lumber and plywood. It is expected that within the next decade as much as 50% of the pulpwood delivered to southern mills will be in the form of byproduct woodchips, up from about 30% currently. In the Northeast, both in Canada and U.S., most of the pulpwood delivered to mills is in roundwood form; however, even in this area there is a trend to using more sawmill chips.

A major drawback to heavy use of residuals is that the availability and cost of chips becomes tied to the housing cycle, which tends to be countercyclical to the pulp industry. The housing downturn in 1980 choked off the flow of byproduct residuals of Pacific Northwest sawmills at a time when pulp production was strong, and this triggered a sharp rise in chip costs. As a result, some pulp and paper mills in the region are now trying to chip more low-value logs. There is also increasing competition for wood residuals in all parts of the U.S. from new structural panel plants (oriented strandboard, waferwood) and from industrial energy users.

MAJOR PULPING PROCESSES

There are five major pulping processes used by North American pulp mills: (1) **sulfate** (kraft), (2) **sulfite**, (3) **semichemical**, (4) **mechanical**, and (5) **defibrated**. Each of these processes produces a different quality and yield of pulp from wood. The mechanical and defibrated processes produce low-quality pulp (i.e., low in strength but high in yield). Semichemical pulp, which is produced mainly from hardwood, is an intermediate-quality pulp at medium levels of yield, 60% to 80%. The chemical pulps have the highest quality of pulp but their yields are lowest, 45% to 55%.

Within each pulping group there are major modifications. For example, in sulfate pulping there are high-yield pulps and low-yield pulps. In mechanical pulping processes, pulp can be produced by at least five modified pulping processes. Besides these processes, there are two minor chemical pulping processes used: the soda process and the prehydrolyzed sulfate process. The soda process has a soda cook, uses either sodium hydroxide or soda ash, and produces a medium-quality chemical pulp from hardwood species.The prehydrolyzed sulfate process produces a dissolving pulp (chemical cellulose) from either hardwoods or softwoods, and these are used to produce rayon, acetate, cellophane or chemical cellulose.

In recent years, a few U.S. and Canadian producers have adopted a new extension of the pulping process, called **oxygen pulping or delignification**. Oxygen delignification is used to remove additional lignin from an alkaline-treated pulp after kraft or soda pulping. The process involves an oxygen reactor vessel located after brownstock washing and before the bleaching sequence.

A direct result of this pulping technique is a large reduction in the total amount of effluent which the

U.S. WOODPULP PRODUCTION

(000 metric tons)

	Total all grades	Special alpha/ dissolv.	Bl. sulfite	Unbl. sulfite	Bl. & semibl. sulfate & soda*		Unbl. sulfate	Semi-chemical	Ground-wood & thermo-mechanical
					Softwood	Hardwood			
1987	54,052	1,190	1,151	155	11,807	11,246	19,302	3,852	5,183
1986	51,725	1,141	1,157	149	11,349	10,567	18,448	3,802	4,978
1985	49,121	1,065	1,238	178	11,001	9,525	17,700	3,653	4,763
1984	50,323	1,094	1,233	235	10,934	9,342	18,798	3,691	4,995
1983	47,586	1,144	1,186	281	10,377	8,772	17,772	3,458	4,597
1982	44,755	991	1,127	313	10,189	7,702	16,484	3,356	4,594
1981	47,212	1,227	1,273	362	10,552	7,656	17,757	3,560	4,826
1980	46,027	1,369	1,324	349	9,867	7,369	17,773	3,652	4,324
1979	44,781	1,360	1,250	358	9,359	7,024	17,762	3,681	3,985
1978	43,032	1,277	1,286	298	9,022	6,494	17,247	3,657	3,750
1977	42,319	1,329	1,499	353	9,016	5,909	16,697	3,516	3,999
1976	41,187	1,348	1,587	380	8,476	5,833	16,171	3,478	3,911
1975	36,838	1,241	1,505	332	6,457	5,114	13,814	3,102	4,003
1974	40,676	1,607	1,736	354	6,960	5,812	15,407	3,437	4,074
1973	41,084	1,517	1,742	338	6,646	5,479	15,955	3,531	4,393
1972	39,544	1,521	1,629	302	6,247	5,103	15,668	3,443	4,180
1971	37,211	1,528	1,503	334	5,915	4,616	14,373	3,256	4,279
1970	37,050	1,557	1,733	361	5,683	4,803	14,206	3,091	4,066
1965	28,855	1,348	2,077	454	3,961	2,822	10,695	2,606	3,540
1960	21,755	1,032	1,855	483	3,754	1,191	7,878	1,807	2,959
1955	17,570	892	1,732	586	2,659	646	6,962	1,264	2,450
1950	12,447	434	1,478	672	2,100		5,179	611	1,973

* Bureau of the Census data show that semibleached sulfate production declined from 1.729 million metric tons in 1970 to 1.078 million tons in 1980—the last year production was broken out; soda pulp production was last shown by Census at 181,000 tons in 1974.

Source: American Paper Institute.

conventional bleach plant would normally produce. Since the lignin content leaving the reactor is substantially less than in the conventional process, less bleaching chemical is required in the bleachery. Therefore, most producers use the oxygen pulping stage as a first bleaching stage, but variations have been employed.

There are six oxygen delignification systems operating in the U.S. and one in Canada, and about four more systems are planned in North America. Worldwide, a total of 44 systems have started up since 1970, of which about half are in the Nordic countries and Europe. About seven or eight systems have also been installed in Japan. Use of oxygen delignification is expected to increase because of growing concern over the presence of low levels of dioxin in the discharge from bleached kraft pulp mills (see U.S. Environment section).

The use of **anthraquinone** as a catalyst in kraft and soda pulping has been developed by Canadian Industries Ltd. of Montreal. Mill trials have shown that this organic chemical, when applied in a ratio of about 0.10% to 0.15% to softwood in kraft pulping, typically improves yield by 2% to 3%, reduces alkali consumption by 10% to 15% and shortens cooking time. The AQ apparently speeds up the removal of lignin, allowing the pulp to retain more hemicelluloses.

Since receiving approval by the FDA in 1980 for its use in pulping, perhaps a dozen North American mills have been using AQ on a fairly regular basis, while many more are still conducting mill trials. It will probably take a few more years to determine whether AQ will come into widespread use. Domestic manufacturing capacity for the chemical must be expanded to improve its cost and availability, but chemical suppliers are waiting to see if a market for AQ develops.

A new nonsulfur, ethanol-based pulping process has been developed by Repap Enterprises Corp. and the company is installing an 11,000-tpy pilot plant at its Miramichi, N.B., pulp mill. The Canadian government will contribute about half of the total C$45 million cost of the project, which is scheduled to start up in early 1989. In the Alcell process, woodchips are placed in an ethanol and water solution and processed in an extractor at higher temperatures and pressures than those used in digesters during conventional kraft pulping. This frees about 75% of the lignin. The Alcell process is said to extract lignin from wood in 20 to 40 minutes compared with two to four hours for the kraft method.

After extraction, the residual alcohol is recovered from the pulp by steam stripping. Black liquor from the primary extraction goes through a flash tank that permits the dry lignin to be recovered, while the cellulose can be combined with other pulp to make paper. Repap says the strength of the new pulp is equivalent to kraft pulp. A byproduct of the process is sulfur-free lignin which can be used to make phenolic resins, wood adhesives and a variety of other products. Major advantages of the process include lower capital cost (estimated at 60% of the kraft process) and fewer environmental problems.

U.S. PULPWOOD CONSUMPTION BY PULPING PROCESS

(000 cords of 128 ft^3)

	1986	1985	1984	1983	1982	1981	1980	1970
All processes, total	90,554	84,840	86,948	83,493	77,573	79,350	79,703	67,562
Dissolving and special alpha	2,866	2,551	2,544	2,776	2,407	2,956	3,378	3,673
Sulfite, total	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	3,494	5,016
Bleached	2,661	2,405	3,255	3,104	2,510	2,556	2,618	3,849
Unbleached and soda	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	876	1,167
Sulfate, total	72,175	66,536	68,611	65,322	54,303	62,684	62,408	49,366
Bleached and semibleached	36,671	33,340	33,968	32,427	32,317	29,814	30,110	22,327
Unbleached	35,503	33,832	34,643	32,895	21,986	32,870	32,299	27,039
Groundwood[1]	5,513	5,337	5,508	5,142	4,879	4,547	4,483	4,234
Semichemical	4,081	3,851	3,912	3,798	3,372	3,929	3,853	3,456
Defibrated or exploded	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	2,087	1,818

Consumption by type of wood in 1986 was as follows (000 cords): all processes 62,961 softwood (s), 27,592 hardwood (h); dissolving 2,052 (s), 813 (h); bleached sulfite 1,434 (s), 1,227 (h); bleached sulfate 21,499 (s), 15,173 (h); unbleached sulfate 31,066 (s), 4,437 (h); groundwood 5,006 (s), 507 (h); and semichemical 192 (s 3,889 (h).

n.a. = Not available.

1. Includes chemigroundwood.

Source: Bureau of the Census.

BLEACHING SEQUENCE

Bleaching of woodpulp is required to improve whiteness. Whiteness or brightness is measured optically by testing instruments that indicate brightness points (such as GE, ISO or ELRDER units). Bleaching is accomplished by either oxidizing or reducing chemicals. The major oxidizing chemicals are chlorine, hypochlorites, chlorine dioxide and peroxide. Reducing chemicals are primarily hydrosulfites, principally sodium hydrosulfite.

Chemical pulp is bleached in large multistage bleaching processes by sequential chemical and washing treatment. For kraft pulp, a typical bleaching sequence might be chlorine, caustic, chlorine dioxide, caustic and chlorine

TABULATION OF NORTH AMERICAN PULP & PAPER MILLS

	Companies[1]	Establishments[2]	Paper mills[3]	Total pulp mills	Groundwood	Other mechanical[4]	Semichemical	Sulfite	Kraft	Miscellaneous[5]
Alabama	19	20	18	21	3	1	2	—	13	2
Alaska	2	2	—	2	—	—	—	2	—	—
Arizona	2	2	2	5	2	—	—	—	1	2
Arkansas	11	12	10	9	1	1	—	—	7	—
California	35	43	33	14	—	4	1	—	4	5
Colorado	2	2	1	—	—	—	—	—	—	—
Connecticut	19	21	10	2	—	—	—	—	—	2
Delaware	3	5	4	1	—	—	—	—	—	1
Florida	17	18	11	11	—	1	1	1	8	—
Georgia	32	32	22	21	3	1	1	—	12	4
Idaho	2	3	2	1	—	—	—	—	1	—
Illinois	24	25	13	3	—	1	—	—	—	2
Indiana	13	16	12	2	—	—	1	—	—	1
Iowa	3	3	2	1	—	—	1	—	—	—
Kansas	2	2	2	—	—	—	—	—	—	—
Kentucky	5	7	5	3	—	—	1	—	2	—
Louisiana	12	17	14	19	3	1	4	—	10	1
Maine	19	24	20	23	13	—	—	1	7	2
Maryland	5	5	4	2	1	—	—	—	1	—
Massachusetts	36	49	37	7	—	—	—	—	—	7
Michigan	36	41	36	12	2	1	3	—	3	3
Minnesota	13	16	12	11	6	3	—	—	2	—
Mississippi	12	14	11	9	2	2	—	—	5	—
Missouri	5	5	4	1	—	1	—	—	—	—
Montana	1	1	1	1	—	—	—	—	1	—
New Hampshire	19	23	16	2	—	—	1	—	1	—
New Jersey	24	33	18	3	—	—	—	—	—	3
New Mexico	1	1	1	—	—	—	—	—	—	—
New York	56	70	54	15	4	3	—	1	1	6
North Carolina	18	21	18	13	—	4	1	—	5	3
Ohio	36	44	33	11	—	2	2	—	1	6
Oklahoma	6	8	6	6	—	1	1	—	1	3
Oregon	16	24	16	20	5	3	3	—	7	2
Pennsylvania	45	49	38	8	—	1	2	1	3	1
Puerto Rico	1	1	—	—	—	—	—	—	—	—
South Carolina	12	12	11	11	3	1	2	—	5	—
Tennessee	18	19	12	10	2	1	1	—	2	4
Texas	14	16	12	10	3	1	—	—	6	—
Vermont	7	8	7	2	1	—	—	—	—	1
Virginia	18	18	14	11	2	1	3	—	4	1
Washington	17	25	18	23	5	1	3	6	7	1
West Virginia	2	2	2	—	—	—	—	—	—	—
Wisconsin	43	59	48	35	7	4	2	6	4	12
TOTAL U.S.	383	818	610	361	68	40	36	18	124	75

continued

dioxide (commonly represented as the CEDED process). Other common bleaching stages are peroxide (P) or hypochlorite (H). Other chemicals may be added in each stage to make the bleach plant more efficient in reducing production cost or producing a certain grade.

An example of this practice which is becoming popular today is oxidative extraction. This technique uses oxygen mixed with the pulp before the first extraction stage to reduce bleaching chemicals further downstream in the bleach line. Fully bleached chemical pulps have brightnesses in the 85 to 90 GE range. Semibleached pulps average 70 to 80 GE.

Reductive bleaching is used for brightening groundwood and deinked pulps. Some oxidating agents such as peroxides, chlorine, and hypochlorites are also used. These pulps brighten to only 55 to 65 GE and many times this is done in one stage of bleaching. Some producers do use multistage bleach lines to achieve higher brightness, up to 70 to 80 for new bleached chemi-thermomechanical softwood pulp mills using peroxide bleaching.

SULFATE OR KRAFT PROCESS

The sulfate or kraft process is the most widely used process for the pulping of wood. Since 1950 sulfate has grown from 38% to 67% of total North American pulp capacity. There are currently about 170 kraft mills in the U.S. and Canada, with a combined capacity in 1987 of 54.8 million metric tons. Of this, U.S. mills accounted for 43.3 million tons and Canadian mills about 11.5 million tons.

In this alkaline process, woodchips are cooked under high pressures and temperatures in a solution of sodium hydroxide and sodium sulfide, a solution called white liquor. Woodchips are pulped in large pressure digesters either by batch or continuous processes for one to two hours in a solution of white liquor at temperatures in excess of 170°C (338°F). Depending on the quality of pulp desired, the amount of alkali, cooking time and temperature are varied to produce a pulp of high or low yield on wood. The higher-yield pulps have a higher lignin content and are normally used for such grades as linerboard and the coarser grades of kraft papers. If a pulp is to be bleached, the kraft pulping stage uses stronger conditions to reduce the pulp's lignin content. Since softwood pulps tend to be higher in lignin than hardwood pulps, more chemical is required to cook the pulp to a given lignin content.

The kraft process is a very versatile one. It produces good-quality pulps from nearly all hardwood and softwood species, its chemicals can be recovered economically in a straightforward recovery process, the technology is well understood, and it produces a strong, easily bleachable fiber. The kraft process is also rather attractive from an economic standpoint since the waste material, called black liquor, can readily be washed from the pulp, concentrated, and burned for recovery of energy and chemicals. A well-designed linerboard mill can be 50% or more self-sufficient in energy by burning the waste liquors.

However, the kraft process has certain deficiencies: (1) capital requirements for constructing kraft pulp mills are extremely high (more than $500,000/annual ton) and the mills must be built with corrosive-resistant metals since the liquors from this process are very corrosive; (2) odor

TABULATION OF NORTH AMERICAN PULP & PAPER MILLS (continued)

	Companies[1]	Establishments[2]	Paper mills[3]	Total pulp mills	Groundwood	Other mechanical[4]	Semichemical	Sulfite	Kraft	Miscellaneous[5]
Alberta	5	8	3	4	1	1	—	—	2	—
British Columbia	22	35	10	32	12	1	—	1	18	—
Manitoba	6	6	4	5	2	1	—	1	1	—
New Brunswick	10	11	7	14	6	1	2	2	3	—
Newfoundland	2	3	3	6	4	—	—	2	—	—
Nova Scotia	6	6	5	9	4	1	—	3	1	—
Ontario	27	49	35	37	13	4	2	5	9	4
Quebec	44	78	56	72	34	9	2	10	10	7
Saskatchewan	2	2	1	1	—	—	—	—	1	—
TOTAL CANADA	105	198	124	180	76	18	6	24	45	11

1. Subsidiaries and autonomous divisions of parent companies are counted as separate units. Totals of this column reflect elimination of duplication of names in more than one state or province.
2. Includes headquarters.
3. Includes mills manufacturing paper and/or paperboard, regardless of the number of paper machines and regardless of whether or not one or more pulp mills are located at the site.
4. Includes steam and hot water defibrated, exploded, shredded, cold soda, and chemimechanical woodpulp mills.
5. Includes deinking, rag, soda, rope, flax, bagasse, and cotton linters pulp mills.

Source: *1988 Lockwood-Post's Directory.*

pollution, principally from the sulfur compounds emitted during pulping and recovery, is a serious problem, although most of these odor emissions can be controlled with modern pollution-abatement procedures; (3) the yield of the pulp in the sulfate process is rather low (45% to 55%); (4) explosions caused by molten smelt coming into contact with water present a safety hazard; (5) presence of dioxins (in very low levels) in the discharge of bleached kraft pulp mills.

SULFITE PROCESS

Acid sulfite pulping is the oldest chemical pulping process used in North America, but its use has been declining. While U.S. and Canadian kraft pulp capacity more than quadrupled from 1950 to 1987, sulfite capacity remained almost flat over this period, totaling 3.3 million metric tons in 1987. Of this, about 1.4 million tons was produced in the U.S. and 1.8 million tons in Canada, representing about 60 mills.

The sulfite process uses an acid solution of sulfurous acid and bisulfite salts with high temperatures to dissolve the binding lignins holding the fibers together. Pulping is done in large batch digesters for six to nine hours, depending on the quality of the pulp. A wide range of yields can be produced by the sulfite process. High-yield sulfite (normally called bisulfite pulp) is used for newsprint, and it has yields of about 55%, whereas chemical-grade acid sulfite pulp has much lower yields in the range of 45%.

A number of different chemical bases are used to produce sulfite pulps. Originally the sulfite pulping process used a calcium base; however, it was difficult and uneconomical to recover the spent liquors from this process. Today sulfite processes are based not only on calcium but also on ammonia, sodium, and magnesium. The sodium- and magnesium-based processes offer full chemical recovery, whereas in the ammonia-based process the liquor is burned for energy but its ammonia or nitrogen values are not necessarily recovered. However, the sulfur dioxide from this process can be recovered.

Chemical-grade sulfite pulps find use in fine papers, tissue papers, bristols and other high-quality papers. But

U.S. WOODPULP CAPACITY TRENDS

(000 short tons)

	Total all grades	Dissolving & special alpha	Total sulfite[1]	Bleached* softwood sulfate[2]	Bleached* hardwood sulfate[2]	Unbleached sulfate	Semi-chemical[3]	Mechan-ical	Screenings
1990e	65,309	1,396	1,572	13,987	12,767	22,909	4,746	7,023	7
1989e	63,951	1,395	1,572	13,866	12,543	22,331	4,712	6,623	7
1988e	62,730	1,395	1,572	13,636	12,059	22,042	4,639	6,478	7
1987e	61,715	1,382	1,616	13,461	11,817	21,574	4,627	6,331	7
1986	60,686	1,399	1,703	13,169	11,402	21,381	4,631	6,058	7
1985	59,615	1,454	1,738	12,874	10,750	21,182	4,650	5,964	29
1984	59,001	1,487	1,750	12,490	9,867	21,372	4,652	6,122	29
1983	57,590	1,525	1,788	12,111	9,179	21,206	4,490	5,814	31
1982	57,638	1,606	1,780	12,052	8,705	21,435	4,734	5,780	34
1981	56,831	1,598	1,855	11,757	8,559	20,972	4,597	7,434	58
1980	55,214	1,590	1,909	11,339	8,356	20,288	4,601	7,069	61
1979	53,636	1,551	2,004	10,897	8,078	19,923	4,553	6,572	63
1978	52,714	1,573	2,095	10,442	7,729	19,732	4,572	6,507	65
1977	51,849	1,648	2,525	10,048	7,322	19,552	4,514	6,442	71
1976	50,547	1,571	2,417	9,355	7,227	19,293	4,402	6,204	78
1975	49,502	1,671	2,420	9,025	7,208	18,758	4,246	6,090	84
1974	48,995	1,824	2,401	8,923	7,138	18,451	4,233	5,930	97
1973	48,459	1,754	2,378	8,842	6,936	18,475	4,171	5,802	100
1972	46,760	1,756	2,353	8,971	6,093	17,702	3,937	5,813	137
1971	45,731	1,772	2,414	8,266	6,008	17,091	3,814	4,680	156
1970	44,725	1,736	2,490	7,798	5,781	16,811	3,811	4,799	154

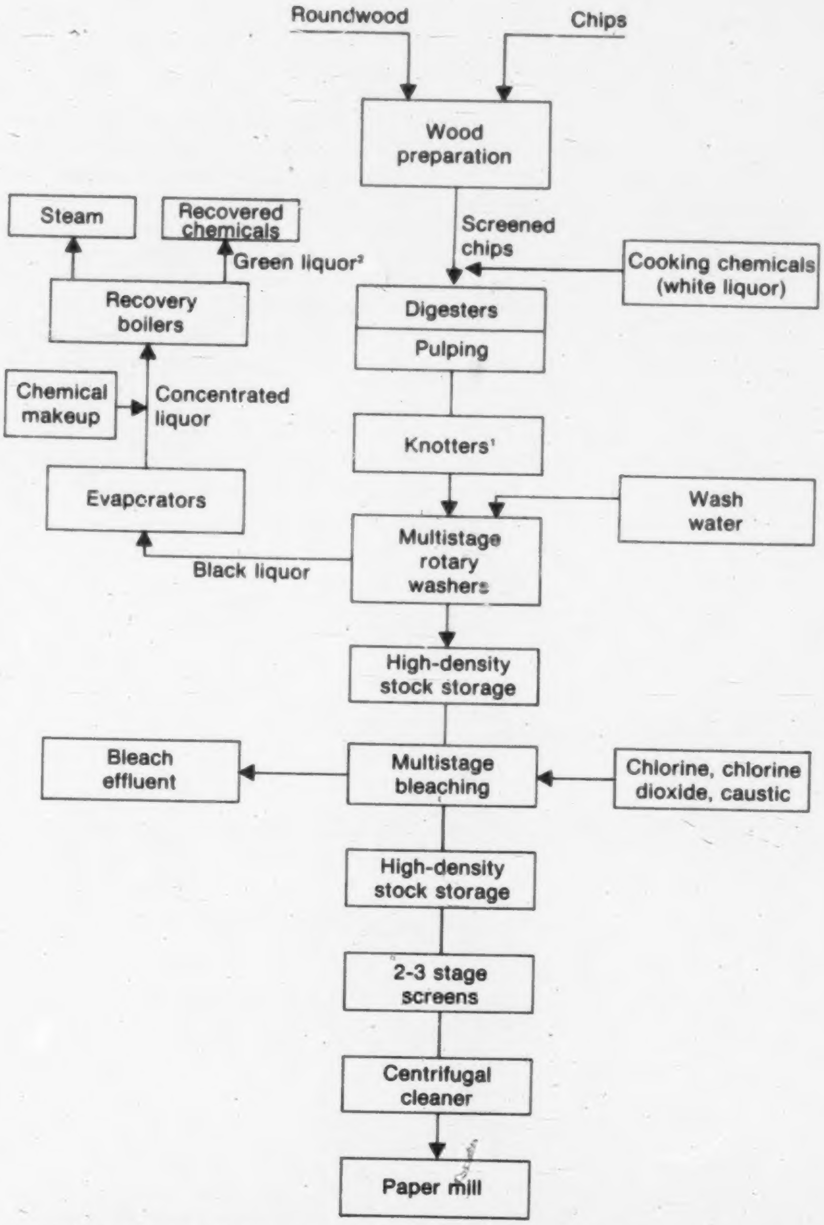
e = Estimate.

* Includes soda pulp.

1. Mainly bleached; unbleached sulfite capacity in 1983 was 400,000 tons.
2. Includes semibleached (1.5 million tons in 1977, the last year for which data were available).
3. Bleached semichemical capacity in 1983 was 361,000 tons.

Source: American Paper Institute.

SIMPLIFIED PROCESS FLOWS FOR KRAFT PULPING


Roundwood
Chips
Wood preparation
Screened chips
Cooking chemicals (white liquor)
Steam
Recovered chemicals
Green liquor[2]
Recovery boilers
Digesters
Pulping
Chemical makeup
Concentrated liquor
Knotters[1]
Evaporators
Wash water
Multistage rotary washers
Black liquor
High-density stock storage
Bleach effluent
Multistage bleaching
Chlorine, chlorine dioxide, caustic
High-density stock storage
2-3 stage screens
Centrifugal cleaner
Paper mill

[1] Some kraft mills use a hot stock refining system before washing. These systems use a refiner to defibrate the unbleached pulp after pulping. The defibrated pulp is then screened bfore washing

[2] Green liquor from recovery is treated in the causticizing process to process white liquor

sulfite pulps produced from either softwoods or hardwoods have poorer strength properties than their equivalent sulfate pulps. This has prevented their use in areas where high strength is required (e.g., linerboard, bag and sack papers).

Among other factors which have caused sulfite to decline from 19% of total North American pulp capacity in 1950 to only 4% in 1988 have been limitations in wood species that can be used, the age and small size of many mills, and the slow development of recovery technology.

SEMICHEMICAL PULPING

Semichemical pulping was developed in the late 1920s at the Forest Products Research Laboratory in Madison, Wis., for the pulping of hardwoods, which were then not used extensively for pulp fiber. Semichemical pulping uses a mild chemical pulping of chips prior to mechanical defibrating. The semichemical pulp produced has a fairly high yield, 60% to 80%, and an intermediate strength level. This pulping process is used principally for pulping hardwood chips, but softwood chips and sawdust can also be used. Hardwood fibers pulped by the semichemical process produce an excellent pulp for corrugating medium, a grade in which this process finds its main use.

The original semichemical process was the **neutral sulfite semichemical** process (NSSC). This process pulps hardwood chips in a solution of sodium sulfite at an alkaline pH. To buffer the acids formed during pulping, soda ash is added. When NSSC pulping was first practiced, it was accomplished in rotary digesters using batch techniques. With the development of continuous digesters such as the Pandia, M&D and Defibrator, most NSSC pulp mills adopted continuous pulping. In continuous digesting retention time is very short, normally not over 30 minutes at temperatures in excess of 170°C (338°F). The spent chemicals and organic materials are either washed or pressed from the pulp, and are either burned in a fluidized-bed incinerator or in specially designed incinerators or recovery units such as Tampella's recovery unit.

A **nonsulfur**-based semichemical process was developed in the late 1960s by Owens-Illinois Inc. This system uses a solution of sodium hydroxide and soda ash to produce a semichemical pulp equivalent in quality to NSSC pulp. It is adaptable to existing processes with only minor modifications. About 50% of the NSSC producers have shifted to the no-sulfur, soda-based cook.

MECHANICAL PULPING

In the mechanical process, pulpwood, used in the form of roundwood or chips, is converted to pulp by mechanical energy. The first process used, and still the predominant one (by a small margin), is the **groundwood** process in which short logs are fed against a rotating disc called a grinder,

U.S. CONSUMPTION OF FIBROUS MATERIALS IN PULP, PAPER, AND BOARD MANUFACTURE[1]

(000 short tons)

Year	Total woodpulp[1]	Total wastepaper[2]	Wastepaper					Other[3]	Cotton linter pulp
			Mixed	News	Corrugated	High-grade pulp substitutes	High-grade deinking		
1986	59,882	15,419	2,115	3,140	7,502	1,253	1,409	288	111
1985	56,639	14,818	2,081	3,031	7,234	1,111	1,360	301	95
1984	50,309	14,944	2,136	3,018	7,231	1,248	1,310	346	92
1983	53,970	14,170	2,059	2,783	6,846	1,262	1,220	334	79
1982	50,186	13,563	1,980	2,790	6,486	1,237	1,148	331	65
1981	52,779	12,872	2,165	2,417	5,919	1,380	991	451	58
1980	51,804	12,583	2,686	2,116	5,628	1,302	851	556	49
1979	51,557	13,012	2,889	2,131	5,737	1,401	854	681	47
1978	49,694	12,481	3,149	3,149	5,187	1,338	786	779	46
1977	49,132	12,103	3,001	3,001	4,839	1,403	784	785	40
1976	47,541	11,874	3,009	3,009	4,618	1,323	771	700	42
1975	42,431	10,367	2,761	2,761	3,950	1,142	650	587	37
1974	48,341	12,098	3,332	3,332	4,669	1,427	615	792	37
1970	43,192	10,594	3,393	3,140	3,511	1,377	493	780	46

1. Woodpulp is also consumed in many nonpaper and board products, such as chemical cellulose, molded pulp products, etc.
2. Census data for wastepaper consumption are lower than those reported by American Paper Institute. See section on wastepaper.
3. Straw, rags, bagasse, etc.

Source: Bureau of the Census.

which grinds off fibers and bundles of fibers which are then sluiced with water into a chest beneath the grinder. Since, at the interface of the grinder and the log, high temperatures are created, there is a plasticizing effect on the lignin and this reduces the energy required to loosen the fibers from the wood mass; this also prevents excessive damage to the fiber. The fibers produced by grinding are short or choppy but of a very high yield (+90%). These pulps are further refined with refiners to remove shives or bundles and to develop some strength properties.

Groundwood pulps are ideal for bulky sheets requiring good opacity—newsprint and low-quality printing grades. Obviously they have poor sheet strength, and because of this some kraft or high-yield sulfite pulp has to be added to grades such as newsprint to give them enough strength to run on paper machines and printing presses. Groundwood pulp capacity in the U.S. and Canada for paper and board production is about 8.1 million metric tons.

Since grinders must accept logs, it is impractical to use chips for producing mechanical pulps. In the early 1960s, it was discovered that chips could be refined, with or without preheating, in large disc refiners which discharge to the atmosphere. The resulting pulps tend to be of longer fiber lengths than groundwood-prepared pulps from the same species. Consequently they have somewhat better strength but also a slightly lower opacity. This process is called **refiner mechanical pulping** (RMP) and, it opened the way for mills, especially in the Pacific Northwest, to use residual chips for the production of mechanical pulps. There is about 780,000 tpy of RMP pulp capacity in North America.

In the late 1960s it was learned that if chips were presteamed and refined under pressure in a disc refiner, a much higher quality of pulp could be obtained. This process, called **thermomechanical pulping** (TMP), has allowed mills to produce a stronger pulp than hitherto thought possible from mechanical processes. In a typical TMP process, softwood chips are presteamed at 110°C (230°F) for one or two minutes, fed via a press feeder or through a pocket feeder into a pressurized refiner having especially designed plates, and then are released under pressure to a stock chest. These pulps are then further refined in a second stage.

Within the last ten years a number of modifications to the TMP process have been made. Some of these processes use chemicals (usually sodium sulfite at various pHs)

CANADIAN PRODUCTION OF WOODPULP

(000 metric tons)

	Total all grades[1]	Dissolving & special alpha	Bl. sulfite	Unbl. sulfite	Bl. hardwood sulfate	Bl. softwood sulfate	Semi-bleached sulfate	Unbl. sulfate	Semi-chemical	Groundwood
1986	21,324	213	445	1,295	1,257	6,413	1,063	1,508	344	8,741
1985	20,036	212	342	1,317	1,136	5,955	1,048	1,479	276	8,234
1984	20,164	228	365	1,431	1,151	5,667	966	1,658	408	8,250
1983	19,768	221	307	1,378	1,021	5,724	1,053	1,752	367	7,913
1982	18,161	219	343	1,407	814	5,141	1,017	1,649	318	7,214
1981	20,261	274	488	1,769	805	5,473	1,009	1,921	392	8,085
1980	20,303	271	463	1,671	794	5,796	1,185	1,998	345	7,748
1979	20,331	311	478	1,806	811	5,471	1,038	2,061	354	7,956
1978	19,783	341	516	1,787	785	5,086	1,054	1,942	318	7,910
1977	17,925	230	636	1,621	680	4,620	1,039	1,574	263	7,226
1976	17,687	222	609	1,649	594	4,672	1,038	1,559	269	7,037
1975	14,850	226	516	1,442	452	3,767	863	1,314	233	6,007
1974	19,359	333	734	1,865	777	4,632	1,096	1,942	329	7,588
1973	18,218	293	507	1,750	893	4,155	1,097	1,922	350	7,196
1972	17,123	370	526	1,711	835	3,556	1,127	1,639	337	6,967
1971	16,235	388	587	1,706	723	3,130	1,150	1,467	301	6,718
1970	16,350	411	684	1,870	3,660[2]		1,084	1,341	285	6,940
1965	13,050	431	817	1,836	1,862		566	1,114	177	6,170
1960	10,255	356	519	1,560	1,062		257	895	203	5,335
1955	9,082	265	566	1,625	663		55	617	141	4,960
1950	7,606	305	386	1,315	396		12	548	94	4,445

1. Excludes defibrated and exploded pulp (51,000 tons in 1986) used mainly in construction grades; about 45,000 tons of screenings are included.
2. Total bleached softwood and hardwood production.

Source: *Statistics Canada.*

before and after the TMP stage; others use steaming and nonpressurized first-stage refining, and others use no steaming and presssurized refining (see table showing definitions).

The most important of these variations is the chemi-thermomechanical pulping (CTMP) process developed mainly in Scandinavia during the 1980s. CTMP differs from TMP mainly in the use of equipment for chip impregnation with chemicals prior to refining. It is usual to start with an impregnation of 2 to 5% of sodium sulfite and chelating agents at a pH of 9 to 12. After this comes preheating for 2 to 5 minutes at 120 to 130°C as in TMP pulping, following by refining. For softwood, the unbleached yield is 92% to 96% depending on the raw material and amount of chemicals used. With peroxide bleaching, a brightness level of about 80 ISO can be reached for softwood CTMP and as high as 87 for hardwood—almost equal to bleached kraft pulp.

The chemical pre-treatment of chips in CTMP gives it the following advantages over TMP: (1) less destructive separation of fibers from the wood, resulting in a higher, longer fiber content and a much lower shive content than in TMP; (2) a more flexible fiber than in TMP, which is reflected in higher sheet density and in higher burst and tensile strength; (3) a higher brightness level before bleaching; (4) more efficient removal of wood extractives from CTMP, which makes it better suited for absorbent grades and food packaging.

In comparison with chemical pulp, bleached softwood kraft has a higher tensile strength, while CTMP has better opacity. Tear strength is about the same for both grades. The most serious drawback of mechanical pulps is color reversion. Most TMP and CTMP are now being used in newsprint, uncoated groundwood and coated publications paper. CTMP is also being used in absorbent products (towels and baby diapers), and bleached board. When TMP or CTMP is used in newsprint, mills can reduce or even eliminate the chemical pulp content in their newsprint furnish.

TMP/CTMP is the fastest-growing pulping process and is overtaking earlier mechanical pulping processes. There is now around 7.8 million metric tons of capacity in North America, and growth is expected to continue. One drawback of TMP/CTMP is its high energy requirement, although methods (pressurized cyclone) are being found to improve steam recovery, which can be used in drying pulp or paper or in heating. TMP/CTMP will soon overtake stone groundwood as the leading pulping process in North America.

Groundwood pulping has been declining, but one recent innovation has been **pressurized groundwood** (PGW) pulping, developed in the late 1970s by Tampella Oy of Finland. The pulp produced by this process has strength values approaching those of TMP with only two-thirds of

CANADIAN WOODPULP CAPACITY

(000 metric tons)

	Total* all grades	Dissolving & special alpha	Bl. sulfite	Unbl. sulfite	Bl. softwood sulfate	Semibl. softwood sulfate	Bl. hardwood sulfate	Unbl. sulfate	Semi-chemical	Mechan-ical
1989e	25.892	253	553	1,322	7,243	1,077	1,521	1,712	455	11,276
1988e	25,371	253	555	1,279	7,191	1,073	1,512	1,717	456	10,855
1987e	24,833	253	573	1,386	7,096	1,139	1,322	1,685	456	10,443
1986	24,509	245	582	1,438	7,023	1,123	1,279	1,682	456	10,201
1985	23,423	266	572	1,414	6,804	1,085	1,253	1,719	449	9,861
1984	23,305	264	371	1,634	6,578	1,127	1,311	1,735	472	9,813
1983	22,889	267	391	1,734	6,492	1,169	1,121	1,734	462	9,519
1982	22,618	305	436	1,950	6,336	1,236	988	1,759	445	9,163
1981	22,424	303	461	2,119	6,371	1,106	955	1,788	445	8,876
1980	21,864	307	426	2,062	6,252	1,198	879	1,752	438	8,550
1979	22,521	395	512	2,100	6,114	1,258	866	1,807	459	9,010
1978	22,014	424	580	2,091	5,699	1,216	852	1,824	455	8,837
1977	22,251	353	727	2,119	5,535	1,191	848	2,062	454	8,924
1976	22,242	408	807	2,134	5,329	1,189	860	2,157	426	8,894
1975	21,960	427	794	2,131	5,256	1,203	877	2,132	400	8,696
1974	21,641	404	689	2,144	5,027	1,264	867	2,087	390	8,716
1973	20,957	416	622	2,107	4,651	1,249	844	1,967	392	8,652

e = Estimate.
* Includes screenings; excludes mechanical pulp for paper and board.

Source: Canadian Pulp & Paper Assn.

the power consumption, or about the same amount of power as required by conventional groundwood. PGW is now being used at more than 15 mills in Europe and the North America (both Madison Paper Co. and Lake Superior Paper Co. are using the process to produce supercalendered paper).

DEFIBRATED PULP PROCESS

This is the simplest way of preparing pulp and it gives the highest yield with less pollution, but obviously the pulp has very poor strength characteristics. Defibrated pulp can be prepared from either softwoods or hardwoods depending on the products produced or the timber available. The first process used to prepare what we now call defibrated pulp was the Masonite process, which steams chips under pressure in a vessel and releases them via a gun or nozzle to atmospheric pressure. The explosion literally blows the pulp into individual fiber masses which are then mixed to make a pulp slurry. This slurry can be used to make coarse grades of paper and board with little or no extra refining. It is ideally suited for making insulation and hardpressed board, and its major use today is still for these products.

In the late 1930s, Defibrator AB of Sweden developed the defibrated pulping process. In this process, pulp is fed continuously to a presteaming vessel under slight pressure and reasonably high temperature, and discharged through a pressurized refiner at the bottom or end of the pulping vessel, where it is defibrated under pressure. The pulp is then discharged to atmospheric pressure to either a live-bottom storage bin or to a stock chest where it is diluted to make a stock slurry. If required, this pulp is again refined, principally to break up fiber bundles and to develop some strength characteristics, and then it is fed to either a cylinder- or fourdrinier-type former.

If the fiber from this process is to be used in a dry process such as for producing hardpressed board, it is not diluted with water but is stored in a live-bottom bin and then fed through a distributor line onto a forming wire. The capacity for making defibrated pulp has grown rapidly during the last 20 years.

DEINKING PROCESS

Deinking is the process of removing inks and in some cases coating and filler from wastepapers, principally newspaper and coated ledgers.

Deinking is primarily practiced at nonintegrated paper mills, and is carried out by two processes: (1) flotation and (2) washing. In the washing system, wastepaper is pulped with chemicals (soda ash, caustic soda, sodium silicates, surfactants, or solvents) in an open pulper either on a continuous or batch basis. The pulp is washed free of ink on conventional rotary washers or on side-hill screens. The washed pulp is then screened and bleached.

Flotation deinking uses air to float off ink particles from the fibers. In flotation deinking, the wastepaper is first sent to a pulper with deinking chemicals, cleaned with screens and centrifugal cleaners and then deinked with flotation cells. Typical chemicals used are sodium peroxide, silicates,

OXYGEN DELIGNIFICATION SYSTEMS INSTALLED OR PLANNED IN NORTH AMERICA

Mill	Startup date
Installed	
Chesapeake, West Point, Va.	1972
E.B. Eddy, Espanola, Ont.	1977 & 1980
Consolidated Papers, Wisconsin Rapids, Wis.	1980
Procter & Gamble, Oglethorpe, Ga.	1980
Union Camp, Franklin, Va.	1981
Union Camp, Eastover, S.C.	1984
Champion International, Pensacola, Fla.	1986 & 1987
Announced	
Champion International, Hinton, Alta.	1989
Daishowa Paper, Peace River, Alta.	1990
Howe Sound Pulp & Paper, Port Mellon, B.C.	1990
Louisiana-Pacific, Samoa, Calif.	1990
Champion International, Canton, N.C.	1991*
Crestbrook Forest Industries, Skookumchuck, B.C.	1992

* Tentative.

THERMOMECHANICAL PULPING CAPACITY TRENDS IN U.S. AND CANADA

(000 short tons)

	Canada	U.S.	Total
1989e	6,027	3,112	9,139
1988e	5,556	3,047	8,603
1987e	4,934	2,980	7,914
1986	4,542	2,660	7,202
1985	4,200	2,499	6,699
1984	3,296	2,453	6,379
1983	3,455	2,188	5,643
1982	2,928	2,048	4,978
1981	1,645	1,723	3,368
1980	1,229	1,371	2,600
1979	790	872	1,662
1978	600	719	1,319
1977	607	567	1,174
1976	417	333	750
1975	76	131	207

e = Estimate.

Sources: Canadian Pulp & Paper Assn., American Paper Institute.

GENERAL DESCRIPTION OF COMMERCIAL PROCESSES FOR PULPING WOOD

Pulp classification	Name of process	Process description	Woods used	Yield of pulp by weight, bl/unbl (%)	Strength of pulp[1]	Pulp usage	Final products	U.S. capacity 1987 (000 short tons)	Number of pulp mills in U.S. 1987[2]
Dissolving	Prehydrolyzed kraft	Woodchips first receive an acid or water hydrolysis to remove pentosans and then are pulped via kraft process. Very high alpha grades receive a cold caustic treatment after kraft pulping.	Softwoods: Southern pine Hardwoods: Gum, oak, southern mixed hardwoods	30-35	Low	Chemically converted into chemicals, plastics, rayon, cellophane, or acetates.		650	3
	Sulfite	Woodchips first are pulped under special acid sulfite pulping conditions. Higher purity achieved via pressure heat treatment or cold caustic treatment stages.	Softwoods: Southern pine, hemlock, spruce Hardwoods: Eastern	30-35	Low	Same as above		850	5
Chemical	Kraft	Woodchips reduced under steam pressure to pulp with alkaline chemicals (sodium hydroxide and sodium sulfide).	Softwoods Hardwoods	42-55 44-49	Softwoods: high to very high. Hardwoods: medium to medium high.	Higher yield pulp used for containerboard. Lower yield pulp used for numerous grades of paper. Often mixed with other pulps.	Strong wrapping and bag paper, containerboard, book, newsprint, highest grade magazine and other printing papers, bond, writing.	Total: 46,851 Bleached & semi-bleached softwood: 13,461 Hardwood: 11,817	125
	Sulfite	Woodchips reduced under steam pressure to pulp with an acid chemical (calcium, magnesium, sodium, or ammonium bisulfite plus sulfurous acid).	Softwoods: Spruce, balsam, hemlock, southern pine Hardwoods: Eastern Lake States	44-49	Softwoods medium to high.	Usually mixed with other pulps. When purified, used for cellulose products.	Book and magazine, wrapping, tissue, newsprint, glassine, writing, cellulose derivatives.	1,717	18

GENERAL DESCRIPTION OF COMMERCIAL PROCESSES FOR PULPING WOOD (continued)

Pulp classification	Name of process	Process description	Woods used	Yield of pulp by weight, bl/unbl (%)	Strength of pulp[1]	Pulp usage	Final products	U.S. capacity 1987 (000 short tons)	Number of pulp mills in U.S. 1987[2]
Chemical (cont.)	Soda	Woodchips reduced under steam pressure to pulp with an alkaline chemical (caustic soda).	Mostly hardwoods: Aspen, cottonwood, basswood, beech, birch, maple, oak, tupelo (gum)	40-48	Medium to medium low	Often mixed with sulfite and other pulps.	Book and magazine, lithograph, other printing papers, envelope, blotting paper.	312	2
Semi-chemical	Neutral sulfite, bisulfite, acid sulfite, kraft, soda, or caustic	Woodchips partially softened under steam pressure with chemicals are reduced to pulp by mechanical action.	Hardwoods: Same as for soda pulp. Red alder. Often pulped in mixtures. Softwoods: Small amounts of Douglas fir, ponderosa pine, and sugar pine.	60-80	Medium to medium low	Alone in corrugating and some other boards. Bleached pulps mixed with softwood pulps for other products.	Corrugating board, food and other specialty boards, glassine, magazine, newsprint, insulating and sheathing board.	4,627	36
Chemi-mechanical	Mason (exploded) Asplund (defibrated)	Woodchips treated with steam or hot water at high temperatures and pressures to soften the wood followed by mechanical fiberization.	Softwoods and hardwoods	80-95	Low to very low	Coarse pulps composed of mixture of single fibers and fiber bundles used alone and mixed with other pulps.	Hardboard, insulating, roofing and linoleum felts.	600	25
	Cold soda	Woodchips given mild treatment with sodium hydroxide solutions and then mechanically fiberized to pulp.	Hardwoods: Birch, maple, beech, oak, sweetgums, aspen. Bagasse. Often pulped in mixtures.	80-95	Medium to low	Often mixed with other pulps.	Printing paper	200	4

GENERAL DESCRIPTION OF COMMERCIAL PROCESSES FOR PULPING WOOD (continued)

Pulp classification	Name of process	Process description	Woods used	Yield of pulp by weight, bl/unbl (%)	Strength of pulp[1]	Pulp usage	Final products	U.S. capacity 1987 (000 short tons)	Number of pulp mills in U.S. 1987[2]
Mechanical	Groundwood (GWP)	Wood bolts reduced to pulp by pressing on a revolving grindstone.	Softwoods: Spruce, balsam, pine, hemlock. Hardwoods: Aspen, cottonwood.	93-93	Low	Usually mixed with chemical pulp.	Newsprint, magazine, book, catalog, tissue/towel, boxboard, building, insulating board.	2,953	65
	Refiner mechanical (RMP)	Woodchips are mechanically fiberized in non-pressurized disc refiners.	Same as GWP	93-93	Low but higher than GWP	Blended with GWP or chemical.	Newsprint	399	8
	Thermomechanical (TMP)	Woodchips are first presteamed and fiberized in pressurized disc refiners.	Same as GWP	90	Low but higher than RMP	Same as above.	Newsprint, publication, fiberboard.	2,980	22
	Chemi-thermomechanical (CTMP)	Woodchips are impregnated with 2% to 5% sodium sulfite prior to refining; otherwise, similar to TMP.		90-95	Higher than TMP but lower than kraft	Same as above.	Same as TMP; also tissue/towel, bleached board, fluff.	0	—
	Pressurized groundwood (PGW)	Groundwood made by grinding logs in a pressurized atmosphere with conventional grinder.		90-93	Nearly as high as TMP	Same as GWP.	Supercalendered papers	320	2

1. A very general rating based on the full range of pulp strengths.
2. Except for kraft and sulfite, nearly every kind of pulp mill must be integrated with a paper or board mill, with excess production being offered for sale.
n.a. = Not available.

Source: Updated by PULP & PAPER from A.D. Little Inc. report for EPA, Environmental Considerations..., Vol. V, Pulp & Paper Industry Report, 1976.

foamers (a soap), and a collector.

There are currently more than 50 mills in North America deinking wastepaper. More than 45 of these are in the U.S. and about six are in Canada. Tissue mills (about 20 installations) account for nearly half of the mills that are deinking. Fort Howard Corp. is a leader in producing deinked tissue using proprietary technology to process less expensive wastepaper grades. About a dozen mills use deinked fibers for printing and writing grades, four for linerboard and boxboard, and seven for newsprint. Garden State Paper Co. is the leading U.S. producer of recycled newsprint. Several small U.S. mills owned by Ponderosa Fibres of America produce deinked market pulp.

In addition to the two main systems, flotation and washing, several other deinking systems are also used. There are three combination systems which have a washing system coupled with a flotation unit to clean the effluent off the washers. Regardless of the type of system, the pulper is usually run batch, while the deinking line draws from a storage tank and is run continuously. However, some systems take pulp out of the pulper continuously and run the deinking line continuously.

Riverside Paper Co. has a unique solvent-extraction system that is used on wastepaper stock such as cupstock, milk carton stock and other difficult-to-clean waste.

DESCRIPTIONS OF MECHANICAL PULPING PROCESSES

Groundwood pulp (GW). Groundwood produced by atmospheric grinding of logs with a conventional stone grinder.

Pressurized groundwood (PGW). Groundwood produced by grinding logs in a pressurized atmosphere with a conventional grinder.

Groundwood from chips (FGP). Groundwood produced by atmospheric grinding of chips with a modified grinder. There is no common abbreviation: the FGP is used by the Japanese inventors—F for fine, and GP for groundwood pulp.

Refiner mechanical pulp (RMP). Atmospheric refining of untreated chips.

Chemirefiner mechanical pulp (CRMP). Atmospheric refining of chemically treated chips.

Chemi-thermomechanical pulp (CTMP). Produced from chips pretreated with chemicals prior to steaming, then refined in pressurized refiner, with or without subsequent pressurized or atmospheric refining stages.

Thermomechanical pulp (TMP). Produced from chips first presteamed and refined in one or more stages of pressurized refining, or followed by atmospheric refining.

Sodium-sulfite-treated TMP (Opco TMP). Process developed by Ontario Paper Co. which involves treating (cooking) TMP pulp (rather than chips before refining) with sodium sulfite.

Sulfonated chip mechanical pulping (SCMP). Patented process of CIP Inc. which is basically chemical pretreatment of chips followed by atmospheric refining (Abitibi-Price and Consolidated-Bathurst both have variations of this process; C-B refers to its process as "Ultra High Yield (UHY)," but this process might be called sulfite pulp or CRMP).

Tandem TMP. Refers to an arrangement of refiners; for example, single stage only (pressurized); two stages (first only pressurized); three stages (only first pressurized).

WASTEPAPER

Wastepaper is used as a lower-grade alternative to virgin pulp in making paper and paperboard. Also referred to as paperstock, recyclable paper, and secondary fiber, it is not as widely used as woodpulp because of quality considerations. Successive repulping tends to lower the quality of the fiber, eventually making it unusable. Often primary fibers are added to maintain strength and other qualities.

The percentage of recyclable paper used in overall fiber furnish in the U.S. has not changed appreciably since 1970, when it was 21.5%. With only minor setbacks, it has continued on an upward trend. It reached 24% in 1986 and dropped slightly to 23.6% in 1987, but it is expected to rise to 24.4%—an all-time high—in 1989, according to the American Paper Institute.

Wastepaper utilization—the ratio of secondary fiber used in proportion to the total paper and paperboard produced—has also varied only slightly over more than two decades. Between 1965 and 1978, it remained at about 23%. After 1978, though, it crept up past 24%, reaching 25.1% in 1986. In 1987, it exceeded 26%.

Aside from slight increases in utilization rates and ratios of usage in overall fiber furnish, another encouraging sign for the wastepaper market in 1987 was record U.S. mill consumption of 19.6 million short tons. This was expected to rise again in 1988.

International trade was also robust in 1987, with U.S. paperstock exports reaching a new record of 4.4 million short tons. The major consuming countries in recent years have been Taiwan, Rep. Korea, Mexico, Japan, Canada, Italy, Spain, and India. The U.S. imported 127,398 short tons, with most of this coming from Canadian sources.

Increased demand for U.S. paperstock put strains on the supply lines throughout 1986 and 1987, causing prices to skyrocket. Most grades moved up at least 25%, while some even doubled. Total collections of recyclable paper in 1987 were approximately 24.0 million tons, an increase from 1986 of 11% or 2.4 million tons.

CONSUMPTION MEASUREMENTS

Indicators of wastepaper consumption used by the industry include the utilization rate and the ratio of wastepaper used to total fiber furnish. Utilization is calculated as a ratio of total paper and paperboard produced. The utilization rate is slightly higher than the other figure due to the loss of fiber in papermaking.

Data on wastepaper consumption are collected by the Dept. of Commerce and API in the U.S., as well as the Canadian government and Canadian Pulp & Paper Assn. in Canada. API figures are generally higher than those from Dept. of Commerce because API includes inplant and intraplant use of paper machine trim and broke and some consumption of wastepaper in government statistics.

SUPPLY

The wastepaper industry collects material from many sources, sorts and segregates it into various types, and processes it for ease of handling, transport, and subsequent repulping. Balers and other costly equipment are required to perform these functions. The collection of wastepaper also provides an important secondary service in reducing solid waste and saving on garbage disposal costs.

Sources of paperstock are categorized generally as either pre- or postconsumer. Preconsumer generators of secondary fiber are primarily converting plants and printers. Converting plants produce recyclable products such as envelopes, books, and business forms. Printers are sources for materials such as magazines, directories, and catalogs. In these operations, waste is generated from machine trim as well as other manufacturing operations. Postconsumer generators of waste include residential homes, factories, offices, and retail outlets.

In determining the supply of paperstock, one of the figures industry experts watch is the recovery rate. This is defined by API as the ratio of recyclable paper collected to new supply of paper and board. (New supply of paper and board equals production plus imports less exports, excluding hard pressed board. Imports and exports include paper and paperboard converted products.)

Overall, the recyclable recovery rate has been climbing upward for the past two decades, with some minor setbacks along the way. It has hovered at about 26% since 1980, but it broke that barrier in 1986 when the rate reached 28%. This was due not only to a 13.3% rise in exports but also to a 7.4% increase in the amount of recyclable paper recovered.

An increasing amount of paper and paperboard is being recycled because of growing concern about the environment as well as the necessity of finding alternate means of disposing of municipal waste. Just in this decade, densely populated areas—particularly in the northeastern U.S.—have had to close down most of their landfills and look for alternate disposal methods.

For example, in New Jersey all but 20 of its landfills had been closed by 1984, and no new ones were being constructed. In response to the crisis, the state enacted in 1987 a law requiring all communities to adopt mandatory recycling programs. During 1987-88, the Paper Stock Institute of the Institute of Scrap Recycling Industries projected, 15 key industrial states will spend over $80 million to support recycling programs. The largest of these will be in Minnesota, Massachusetts, New Jersey, New York, California, and Connecticut.

The collection systems for the major categories of wastepaper differ. Old newspapers are usually generated by residences and kept for donation to nonprofit organizations for paper drives. This is changing, though. With the spread of mandatory recycling efforts, communities also are raising funds through recycling. API reported that total collection of old newspapers in 1987 was 4.4 million short tons, an increase of 13% over 1986.

Old corrugated containers (OCC) are obtained mostly from retail stores, factories, and office buildings. Only about 25% is supplied by postconsumer sources. Corrugated collections in 1987 totaled 11.2 million short tons, a hike of almost 10% above the previous year. Of the total, about two million tons were box plant clippings (new double-lined kraft corrugated clippings) and 9.2 million tons were used containers. The 1987 collection rate was about 45%.

Mixed papers are generated mostly in office buildings and are usually taken away by private haulers. During times of poor demand and falling prices, haulers usually cease picking up mixed papers because—being the cheapest of the wastepaper grades—their price drops below a level that

U.S. WASTEPAPER UTILIZATION BY GRADES

(000 short tons)

Year	Total	Mixed papers	%	News-papers	%	Corru-gated	%	Pulp subs*	%	Deink-ing	%
1990e	21,518	2,335	11%	3,621	16%	10,514	49%	3,178	15%	1,869	9%
1989e	21,000	2,236	11	3,420	16	10,322	49	3,163	15	1,859	9
1988e	20,050	2,150	11	3,323	17	9,764	49	3,012	15	1,800	9
1987e	19,206	2,096	11	3,241	17	9,214	48	2,926	15	1,729	9
1986	18,128	2,045	11	3,118	17	8,634	48	2,761	15	1,570	9
1985	16,550	1,902	12	2,875	17	7,899	48	2,494	15	1,380	8
1984	16,883	1,975	12	2,895	17	7,972	47	2,673	16	1,369	8
1983	15,822	1,908	12	2,692	17	7,443	47	2,456	16	1,323	8
1982	14,620	1,707	12	2,673	18	6,770	46	2,247	15	1,224	8
1981	15,883	2,356	15	2,667	17	7,231	46	2,382	15	1,247	8
1980	15,094	2,268	15	2,564	17	6,866	45	2,254	15	1,142	8
1979	15,520	2,648	17	2,480	16	6,967	45	2,308	15	1,117	7
1978	14,760	2,729	18	2,212	15	6,721	45	2,242	15	1,068	7
1977	14,288	2,773	19	2,287	16	6,205	43	2,079	14	944	7
1976	13,822	2,798	20	2,278	17	5,696	41	2,117	15	933	7
1975	11,983	2,606	22	2,040	17	4,743	40	2,594*	22	—	—
1974	14,196	3,118	22	2,408	17	5,716	40	2,955*	21	—	—
1973	14,318	3,371	24	2,456	17	5,292	37	3,199*	22	—	—
1972	13,132	3,054	23	2,317	18	4,722	36	3,037*	23	—	—
1971	12,323	2,776	22	2,174	18	4,277	35	3,097*	25	—	—
1970	12,021	2,639	22	2,235	19	4,080	34	3,067*	25	—	—

* Pulp substitutes include deinking grades prior to 1976.
e = American Paper Institute estimate.

Source: American Paper Institute Capacity Survey for relevant years, 1970-90.

would make collection profitable.

Collections of mixed papers totaled 2.8 million short tons in 1987, down 4.3% from 1986. This was because export demand for mixed papers did not increase as rapidly as for old newspapers and OCC, due to the increasing contamination of plastics, metals, and other nonfibrous materials in the bales of mixed papers.

High grades of wastepaper are usually obtained from large office buildings, where an agreement is worked out with a paperstock dealer. More corporations and commercial landlords are starting to collect office papers to reduce their waste disposal costs, as well as to make some additional money from selling the refuse. Usually this is done by having employees sort their own office discards and take them to a central collection point in the building, where the refuse is subsequently picked up by a private hauler.

Total collection of high grades for deinking and pulp substitutes in 1987 was 5.5 million short tons, up almost 16% from the previous year. This reflected the increasing yield of clippings from factories making paper products such as envelopes, business forms, and printed brochures. Demand for the high grades was also good as mills shifted more of their fiber furnish needs to secondary fiber from woodpulp.

UTILIZATION OF WASTEPAPER BY U.S. PAPER/BOARD MILLS

(000 short tons)

Year	Wastepaper used*	Paper/board produced	Utilization rate (%)
1989e	21,000	81,800	25.7%
1988e	20,050	79,800	25.1
1987e	19,206	74,480	25.6
1986	18,128	70,855	24.9
1985	16,550	68,830	24.0
1984	16,883	70,268**	24.0
1983	15,822	66,764**	23.7
1982	14,620	60,962**	24.0
1981	15,883	64,259	24.7
1980	15,094	63,537	23.8
1979	15,520	64,345	24.1
1978	14,760	62,047	23.8
1977	14,288	60,040	23.8
1976	13,822	58,329	23.7
1975	11,983	50,976	23.5
1974	14,196	59,040	24.0
1973	14,318	59,900	23.9
1972	13,132	57,433	22.9
1971	12,323	53,162	23.2
1970	12,021	51,671	23.3

e = Estimate.

* Includes the following tonnage consumed in the manufacture of molded pulp products: 1982, 187,000 tons; 1983, 174,000 tons; 1984, 157,000 tons; 1985, 179,000 tons; 1986, 191,000 tons; 1987-89, 202,000 tons.

** Includes the following tonnages for construction and wet machine board grades: 1982, 1,662,000 tons; 1983, 1,800,000 tons; 1984, 1,800,000 tons; 1985, 1,800,000 tons.

Sources: Wastepaper utilization from American Paper Institute Capacity Survey for relevant years. Production totals from API "Statistics of Paper, Paperboard & Wood Pulp" and from "Paper, Paperboard & Wood Pulp Monthly Statistical Survey."

GRADES

Mixed papers, news, old corrugated, pulp substitutes, and deinking are the five official grade categories used by the Dept. of Commerce and generally accepted by the industry as key benchmarks for numerous other grades. The Paper Stock Institute subdivides the five classifications into more definitive grades.

These include 49 regular grades which comprise the bulk of the wastepaper traded in the U.S. and Canada, along with 31 specialty grades which are sold to a limited number of mills that are able to use them in their product mixes. The latter grades generally include contaminants, such as plastic coatings and foil, which restrict their use.

Grade characteristics:

- Mixed paper: paper of varied quality, often office waste; also boxboard cuttings and mill wrappers.
- News: old newspapers, either collected from households or over-issues at newsstands or inplant; also

U.S. WASTEPAPER DOMESTIC UTILIZATION AND EXPORTS

(000 short tons)

	Used	Exported	Total	Exports as percent of total
1987	19,617	4,422	24,039	18%
1986	17,887	3,749	21,636	17
1985	16,371	3,286	19,657	17
1984	16,724	3,235	19,959	16
1983	15,638	2,574	18,212	14
1982	14,433	2,127	16,560	13
1981	15,037	2,213	17,659	13
1980	14,922	2,664	17,972	15
1979	15,361	2,233	17,594	13
1978	14,760	1,599	16,359	10
1977	14,058	1,512	15,570	10
1976	13,622	1,273	14,895	9
1975	11,748	861	12,843	7
1974	13,982	1,307	15,289	9
1973	14,094	683	14,777	5
1972	12,925	415	13,340	3
1971	12,106	419	12,525	3
1970	11,803	408	12,211	3

e = Estimate.

Source: American Paper Institute.

groundwood paper trim.

- Old corrugated containers: used corrugated containers; also container plant cuttings.
- Pulp substitutes: unprinted grades of brown and colored kraft, white and semibleached sheets and cuttings, tabulating cards, and shavings or trim of unprinted grades.
- Deinking: deinking grades of white and colored ledger, computer printout (CPO), coated book and groundwood paper, and bleached sulfate sheets and cuttings.

MARKETS

Markets for the various grade classifications of wastepaper are essentially different, although there is some crossover in the types of paper and board made from different furnishes. For instance, clay-coated newsback can incorporate OCC, old news, and pulp substitutes.

Mixed papers, the cheapest grade of paperstock, are used in construction paper and board products such as roofing felts and gypsum wallboard. A shift from paper-based roofing to fiberglass-based shingles has cut demand substantially for mixed papers in this market. However, an increase in housing starts in recent years has boosted demand for mixed papers in gypsum wallboard production.

Early in the 1980s, a drop in housing starts due to high interest rates caused mixed-paper demand to plummet and supplies to reach record levels. This situation resulted in dealers turning down much of the shipment of mixed papers from generators until 1985, when demand started picking up again. Prices, however, remained relatively low but flat.

Demand for OCC, mainly from linerboard and corrugating medium mills, has risen dramatically in recent years. This had caused prices in many markets to at least double by mid-1987, compared with mid-1985. On the West Coast, for instance, mills were paying premiums as high as $100/short ton f.o.b. seller's dock.

This sharp improvement in OCC markets was caused not only by a substantial rise in demand from domestic mills but also by significant improvement in overseas shipments. The Dept. of Commerce reported that OCC exports in 1986 were up 16.5% from a year earlier.

The old news market also improved during 1985 and 1986 and remained firm in 1987. Its performance was not as remarkable as OCC, however. Price improvement was more notable on the coasts due to a 22.6% hike in export demand in 1986, but supplies in most areas were generally balanced rather than tight. A pickup in demand for newsprint—the chief consumer of old news—was expected to bolster the market through 1989.

High grades tend to suffer least during fluctuations in market conditions. However, this has not been true for deinking grades—especially CPO—in recent years. Because of the increasing use of contaminants, deinking grades have become more costly to prepare for repulping. This has resulted in a decline in prices as well as in demand.

In late 1986, large deinking-grade consumers such as tissue mills began to increase their orders for deinking grades, as market factors drove up prices for other grades

WASTEPAPER AS PERCENT OF FIBER FURNISH IN U.S. PAPER/BOARD PRODUCTION

(000 short tons)

	Waste-paper	Total wood-pulp, other fibers	Percent of waste-paper
1989p	21,000	61,352	25.4%
1988p	20,050	59,451	25.1
1987p	19,206	58,090	24.8
1986	18,128	55,582	24.5
1985	16,550	53,308	23.6
1984	16,883	55,174	23.3
1983	15,822	51,834	23.2
1982	14,620	48,440	23.2
1981	15,217	51,764	22.7
1980	15,094	51,028	22.8
1979	15,400	51,303	23.1
1978	14,760	54,074	21.5
1977	14,288	49,799	22.3
1976	13,822	48,082	22.3
1975	11,983	43,104	21.8
1974	14,196	49,130	22.4
1973	14,318	49,558	22.4
1972	13,132	48,032	21.5
1971	12,323	44,805	21.5
1970	12,021	43,802	21.5

p = Preliminary.
Calculated by *Pulp & Paper* from American Paper Institute data.

WASTEPAPER CONSUMPTION IN U.S. MILLS AS REPORTED BY CENSUS AND API

(000 short tons)

	Census	API
1985	14,816	16,371
1984	14,944	16,724
1983	14,037	15,638
1982	12,835	14,433
1981	13,381	15,037
1980	12,583	14,922
1979	13,012	15,361
1978	12,586	14,760
1977	12,103	14,058
1976	12,616	13,622
1975	10,367	11,748
1974	12,098	13,982
1973	12,374	14,094
1972	11,703	12,925
1971	11,000	12,106
1970	10,594	11,803

Sources: Bureau of the Census, M26A data; American Paper Institute, Statistics of Paper.

PRICES FOR WASTEPAPER BY SELECTED GRADE IN FOUR MARKETS

($/short ton, f.o.b. seller's dock)

NO. 1 NEWS

	NYC	Chicago	Atlanta	SF-LA
1987				
4Q	$55.00	$54.17	$49.17	$75.00
3Q	44.16	40.83	38.33	75.00
2Q	47.50	42.50	40.83	71.66
1Q	40.00	37.50	42.50	65.83
1986				
4Q	25.00	24.16	30.00	40.00
3Q	31.67	32.50	41.67	46.67
2Q	35.00	30.83	35.00	45.00
1Q	30.00	22.50	37.50	48.12
1985				
4Q	25.00	24.16	30.00	40.00
3Q	25.83	25.00	29.17	40.83
2Q	56.25	47.50	65.00	53.44
1Q	40.83	43.33	35.00	48.12
Year-end				
1984	42.50	47.50	42.50	45.00
1983	42.50	47.50	47.50	51.25
1982	30.00	37.50	32.50	45.00
1981	27.50	22.50	32.50	30.00
1980	45.00	50.00	57.00	53.50

OLD CORRUGATED CONTAINERS

1987				
4Q	54.17	54.17	70.00	99.17
3Q	71.66	70.00	76.66	104.16
2Q	47.50	42.50	40.83	71.66
1Q	40.00	37.50	42.50	65.83
1986				
4Q	22.50	25.00	32.50	46.66
3Q	45.83	50.83	55.00	77.50
2Q	33.33	36.67	35.83	55.00
1Q	25.00	26.66	32.50	46.25
1985				
4Q	22.50	25.00	32.50	46.66
3Q	24.17	25.00	30.83	45.00
2Q	60.00	62.50	81.25	63.13
1Q	30.00	35.62	37.50	46.25
Year-end				
1984	37.50	46.25	50.00	50.00
1983	47.50	60.00	67.50	70.00
1982	30.00	30.00	37.50	32.50
1981	27.50	33.50	34.50	40.00
1980	33.00	44.00	43.00	57.00

Note: Prices reflect paper and board mill purchase prices, f.o.b. seller's dock exclusive of delivery charges, and they represent contract rather than spot or premium sales.

Source: *Pulp & Paper Week.*

PRICES FOR WASTEPAPER BY SELECTED GRADE IN FOUR MARKETS

($/short ton/f.o.b. seller's dock)

NEW DOUBLE-LINED KRAFT CORRUGATED CLIPPINGS

	NYC	Chicago	Atlanta	SF-LA
1987				
4Q	$83.33	$95.83	$97.50	$135.00
3Q	105.00	110.00	107.50	151.66
2Q	97.50	98.33	97.83	150.00
1Q	82.50	82.50	85.83	130.83
1986				
4Q	42.50	38.33	52.50	75.83
3Q	81.67	87.50	90.83	103.33
2Q	65.00	65.00	60.83	80.00
1Q	50.83	46.66	54.16	76.66
1985				
4Q	42.50	38.33	52.50	75.83
3Q	44.75	40.83	54.17	81.67
2Q	80.00	80.00	107.50	86.56
1Q	78.12	67.50	73.75	92.50
Year-end				
1984	77.50	83.75	77.50	92.50
1983	72.50	77.50	82.50	100.00
1982	45.00	47.50	47.50	70.00
1981	n.a.	n.a.	n.a.	n.a.
1980	n.a.	n.a.	n.a.	n.a.

HARD WHITE SHAVINGS

1987				
4Q	296.66	306.66	308.33	345.00
3Q	276.66	275.00	393.33	323.33
2Q	276.66	266.66	293.33	321.66
1Q	285.83	285.00	291.66	316.66
1986				
4Q	180.00	145.00	160.00	188.33
3Q	248.33	226.67	218.33	253.33
2Q	210.00	185.00	188.33	220.83
1Q	187.50	151.66	166.66	195.00
1985				
4Q	180.00	145.00	160.00	183.33
3Q	151.25	145.00	140.00	130.00
2Q	203.75	170.00	205.00	237.50
1Q	235.00	200.00	225.00	237.50
Year-end				
1984	245.00	205.00	240.00	245.00
1983	212.50	215.00	210.00	195.00
1982	200.00	195.00	190.00	180.00
1981	252.50	231.00	232.50	237.50
1980	251.50	278.50	260.00	269.50

Note: Prices reflect paper and board mill purchase prices, f.o.b. seller's dock exclusive of delivery charges, and they represent contract rather than spot or premium sales.
n.a. = Not available.

Source: *Pulp & Paper Week.*

PRICES FOR WASTEPAPER BY SELECTED GRADE IN FOUR MARKETS

($/short ton, f.o.b. seller's dock)

COMPUTER PRINTOUT

	NYC	Chicago	Atlanta	SF/LA
1987				
4Q	$193.33	$166.66	$233.33	$278.33
3Q	185.00	165.00	215.00	245.00
2Q	185.00	165.00	200.00	235.00
1Q	175.00	165.00	186.66	231.66
1986				
4Q	135.00	126.66	140.83	166.66
3Q	169.17	180.00	192.50	228.33
2Q	143.33	130.00	175.00	209.17
1Q	135.00	125.00	144.16	180.00
1985				
4Q	135.00	126.66	140.83	166.66
3Q	135.00	133.33	140.00	156.67
2Q	160.00	177.50	215.00	188.75
1Q	203.75	170.00	205.00	237.50
Year-end				
1984	205.00	170.00	205.00	245.00
1983	172.50	160.00	155.00	190.00
1982	170.00	145.00	155.00	192.50
1981	177.50	203.50	183.50	178.50
1980	175.50	195.00	158.50	199.00

MANIFOLD WHITE LEDGER

1987				
4Q	155.00	165.00	167.50	195.00
3Q	141.66	151.66	158.33	175.00
2Q	133.33	136.66	141.66	168.33
1Q	115.83	116.66	127.50	155.00
1986				
4Q	99.16	94.16	95.00	100.00
3Q	114.17	103.33	91.67	118.33
2Q	92.50	93.00	90.00	97.50
1Q	94.16	92.50	90.00	92.50
1985				
4Q	99.16	94.16	95.00	100.00
3Q	102.50	100.00	111.67	103.33
2Q	125.00	135.00	142.50	137.50
1Q	151.25	145.00	140.00	130.00
Year-end				
1984	146.25	145.00	140.00	147.50
1983	132.50	125.00	109.50	120.00
1982	90.00	100.00	95.00	105.00
1981	137.50	128.50	131.00	146.00
1980	136.50	151.50	140.50	160.50

Note: Prices reflect paper and board mill purchase prices, f.o.b. seller's dock exclusive of delivery charges, and they represent contract rather than spot or premium sales.

Source: *Pulp & Paper Week.*

that can be substituted for deinking grades. Between 1985 and 1986, mills switched to grades such as the pulp substitutes.

Among the deinking grades, demand for CPO has been particularly depressed because of more widespread use of laser printers, which burn impressions into the paper. So far, no technology has been accepted by the industry as a viable means of eliminating the ink from laser-printed CPO.

The pulp substitutes, the cleanest and most expensive of the wastepaper grades, staged the sharpest and most substantial rebound in demand and pricing between 1985 and 1987. Prices in most parts of the country rose by $100 to $200 to a high of $400 for hard white envelope cuttings in the Los Angeles area. This was due to an escalation in orders, especially during 1986 and 1987, as virgin pulp prices continued to rise due to limited supplies and increased demand. Faced with these increased costs, mills switched to using paperstock for more of their fiber furnish.

Unlike other sectors of the pulp, paper, and paperboard industry, the consumer of wastepaper usually sets the price. When mills want to generate more paperstock due to

PRICES FOR WASTEPAPER BY SELECTED GRADE IN FOUR MARKETS

($/short ton, f.o.b. seller's dock)

MANIFOLD COLORED LEDGER

	NYC	Chicago	Atlanta	SF/LA
1987				
4Q	$112.50	$137.50	$118.33	$110.83
3Q	90.83	121.66	111.66	107.50
2Q	85.83	106.66	91.66	107.50
1Q	78.33	90.00	90.00	102.50
1986				
4Q	79.16	80.00	73.33	70.00
3Q	88.33	81.67	85.00	72.50
2Q	72.50	81.67	77.50	77.50
1Q	72.50	80.00	72.50	68.33
1985				
4Q	79.16	80.00	73.33	70.00
3Q	82.50	85.00	86.67	73.33
2Q	110.00	110.00	115.00	113.13
1Q	118.75	125.00	120.00	87.50
Year-end				
1984	115.00	125.00	120.00	117.50
1983	112.50	105.00	90.00	65.00
1982	67.50	90.00	85.00	55.00
1981	110.00	112.50	107.50	115.00
1980	127.50	122.50	127.50	127.50

Note: Prices reflect paper and board mill purchase prices, f.o.b. seller's dock exclusive of delivery charges, and they represent contract rather than spot or premium sales.

Source: *Pulp & Paper Week.*

projected shortfalls in supplies, they raise prices and cause generators to take interest in the market again. Conversely, prices are cut when the intention is to slow the flow.

The exception occurs during a shortage, when demand picks up faster than additional supplies can be generated. This does not happen often, however, as mills have become increasingly more adept at spotting upcoming changes in the marketplace. In addition, more primary producers are themselves getting involved in recycling, integrating their operations fully or partially to eliminate or reduce the need for a middleman such as a dealer or broker of paperstock.

Secondary fiber prices react quickly to changes in the entire industry, and they are considered a bellwether of future market conditions. Most industry experts think wastepaper prices will continue to vacillate suddenly and sharply unless supplies are substantially reduced by construction of waste-to-energy facilities throughout the country or by other factors that would limit supplies.

EXPORTS/IMPORTS

The U.S. is by far the largest exporter of wastepaper. In 1987, U.S. paperstock exports reached an all-time high of 4.42 million short tons.

The three largest consumers of U.S. paperstock in 1986 were Taiwan (891,691 tons), Rep. Korea (839,714 tons), and Mexico (564,333 tons). Together these countries accounted for 61.1% of 1986 U.S. wastepaper exports.

U.S. wastepaper exports have grown rapidly during the past two decades, rising from 408,000 short tons in 1970. Aside from the record reached in 1986, each of the years after 1982 showed all-time highs. In 1982, however, exports dipped 3.8% due to a worldwide recession. But they jumped 12.5% in 1983 to 2.393 million short tons.

The U.S. imports less than 1% of its requirement for wastepaper, and most of this (96% in 1986) comes from Canada. Import levels have varied up and down over the past two decades. In 1977, for instance, U.S. mills imported a record 106,444 short tons. This dipped to 91,013 tons in 1978 and 69,719 in 1979. It was not until 1984 that a new record, 109,712 tons, was reached. In the past two years, though, imports have been down again.

Paper Stock Institute representatives forecasted more improvement in export markets for U.S. paperstock through 1988. But the weakening of the U.S. dollar in relation to other currencies during 1986 may have caused some sluggishness in overseas production and reduced 1988 foreign demand for U.S. paperstock.

The demand from Rep. Korea and Taiwan was expected to remain robust in the long-term. Mexico should continue to be a good market for U.S. wastepaper exporters, provided that country can keep its economy afloat. And Japan should be opening up to secondary fiber imports due to improved trade with China, especially for linerboard.

U.S. WASTEPAPER EXPORTS TO MAJOR CONSUMING COUNTRIES, 1986

(000 short tons)

	News	High-grade deinking	High-grade pulp substitutes	Corrugated	All other	Total	Percent of market
NORTH AND SOUTH AMERICA							
Canada	13,498	14,988	32,968	135,959	28,802	226,215	6.07%
Mexico	216,554	23,891	146,055	172,328	5,505	564,333	15.15
Others	1,286	9,698	8,020	36,413	28,192	83,609	2.25
Total	231,338	48,577	187,043	344,700	62,499	874,157	23.47
EUROPE/AFRICA/ MIDDLE EAST							
Italy	4,317	25,888	1,285	78,425	44,497	154,412	4.15
Spain	3,659	20,103	2,503	86,703	21,238	134,206	3.60
Others	2,236	17,869	1,583	28,108	19,870	69,666	1.87
Total	10,212	63,860	5,371	193,236	85,605	358,284	9.62
FAR EAST/OCEANIA/ AUSTRALIA							
India	21,780	30,522	5,563	33,188	35,841	126,894	3.40
Japan	13,511	39,859	33,902	181,104	130,688	399,064	10.71
Rep. Korea	282,326	143,982	38,897	311,052	62,457	838,714	22.52
Taiwan	164,006	92,644	31,923	361,314	241,804	891,691	23.94
Others	42,659	27,522	9,540	100,303	56,046	236,070	6.34
Total	524,282	334,529	119,825	986,961	526,836	2,492,433	66.91
TOTAL	765,832	446,966	312,239	1,524,897	674,940	3,724,874	100.00%

Source: National Assn. of Recycling Industries from Dept. of Commerce.

CANADA'S TRADE AND USE

Canada still remains one of the top five export customers for U.S. paperstock, but its ranking has dropped from second to fifth place since 1980. It is still the chief supplier of U.S. imported wastepaper; however, the import market meets less than 1% of U.S. mills' secondary fiber requirements. Canada, on the other hand, represents 6.1% of the export market for U.S. paperstock.

Canadian dependence on U.S. wastepaper has declined in recent years. Since 1984, Canada has imported less than 300,000 tpy from the U.S., dropping to a level of 226,215 tons in 1986 but rising to 286,898 tons in 1987. Canadian mills, however, have positioned themselves to use more wastepaper overall. According to the Canadian Pulp & Paper Assn., in 1986 more than 40 of Canada's 168 pulp mills were equipped to handle recyclable paper. The declining trend in paperstock imports from the U.S. appeared to be changing in 1987, and it seems likely to continue in 1988.

Along with this, Canadian mills have been increasing their wastepaper usage. Canadian recyclable paper consumption rose steadily between 1975 and 1986 to 1.442 million metric tons, according to the CPPA. Of this, 829,480 tons were container grades, 355,475 tons were pulp substitutes and other grades, 220,331 tons were news grades, 103,975 tons were mixed papers, and 80,640 tons were boxboard cuttings.

PULPING

Pulping wastepaper is considerably simpler than pulping wood. The process involves separating the web or sheet into individual fibers. Removal of any ink is considered a separate process and is called deinking.

A pulper is generally used in pulping secondary fiber. It is filled with water, and wastepaper is added, usually from a conveyor belt, until a consistency of at least 5% to 6% recyclable paper is reached. A spinning rotor in the bottom of the pulper tears the paper into smaller pieces. These pieces, in turn, rub against one other to further break down the fibers. Stock removed from the pulper normally passes through a screen to remove pieces that have not been sufficiently broken down.

Chemically treated or coated wastepaper, which may be more difficult to repulp, requires further processing. Usually the water in the pulper is heated to 65°C (150°F), and chemicals such as sodium hydroxide or soaps and dispersing

U.S. WASTEPAPER EXPORTS, 1970-88

(short tons)

	News	Corrugated	High-grade deinking	High-grade pulp substitutes	Other	Total
1987	869,743	1,920,719	525,860	365,419	736,691	4,418,432
1986	765,832	1,524,897	446,966	312,239	674,940	3,724,874
1985	624,644	1,310,852	290,486	178,975	879,042	3,283,999
1984	540,459	1,263,043	296,274	251,200	917,201	3,268,177
1983	461,153	993,436	224,701	189,578	750,463	2,393,381
1982	444,093	886,655	140,349	163,790	492,131	2,127,018
1981	425,060	991,115	130,319	192,192	473,863	2,212,549
1980	424,864	1,208,609	176,442	204,881	649,395	2,664,191
1979	336,138	960,369	134,959	153,950	647,686	2,233,102
1978	366,005	576,653	93,307	92,452	471,032	1,599,449
1977	644,038	591,529	301,273[1]	—	341,526	1,878,366[2]
1976	244,118	426,104	300,096[1]	—	302,418	1,272,626
1975	164,294	333,631	178,145[1]	—	187,318	861,388
1974[3]	—	—	—	—	—	1,307,000
1973[3]	—	—	—	—	—	683,444
1972[3]	—	—	—	—	—	415,033
1971[3]	—	—	—	—	—	419,046
1970[3]	—	—	—	—	—	408,000

1. Includes "high-grade pulp substitutes."
2. Subsequent revision by Census changed total to 1,544,000 tons, due to errors reported in exports to Greece and Canada; revision does not indicate which wastepaper grades are affected by the change.
3. No grade designations prior to 1975.

Source: Bureau of the Census.

agents are added.

In the deinking operation, washing equipment and special chemicals lift or remove ink from the paper. Some wastepaper, however, is difficult or impossible to deink economically because of plastics or pressure-sensitive adhesives in the paper.

Laser printing has become more widespread in recent years, increasing the problem of removing ink that is burned in. The cost of deinking, in some cases, can approach the cost of buying virgin fiber in a weak market, thus pricing such grades as CPO out of the market. The alternative is to switch to cleaner, but often more costly, grades.

GOVERNMENT INVOLVEMENT

Since the 1970s, wastepaper recycling has grown from a private-sector occupation to a public concern related to environmental issues and to the practical problem of solid-waste disposal. States in the densely populated Northeast have been particularly pressed to find alternatives to landfills, which have been disappearing at an alarming rate in recent years.

At the same time, paper and paperboard remain the major component in the municipal solid-waste stream. According to a 1987 report by Franklin Associates Ltd., entitled "Characterization of Municipal Solid Waste in the U.S., 1960-2000," paper and paperboard refuse grew to a level of 50 million short tons in 1984 from 24.5 million tons in 1960. This is projected to rise to about 65 million tons by 2000.

But as the garbage levels rise, the means of disposal diminish. In 1979, state and local governments nationwide completed initial environmental assessments on nearly 20,000 active solid-waste disposal sites and began a program to close those that were not in compliance with standards. The result was a loss of landfill sites at the rate of about 1,500/year in the early 1980s.

In response to dwindling landfill space, governments began to build resource recovery facilities to burn wastes and produce energy. However, by 1984, fewer than 60 of these disposal systems were processing less than 10% of the nation's municipal garbage. Also, by this time it was discovered that these plants were extraordinarily expensive to operate and created their own pollution. The alternative chosen by most communities was to recycle as much refuse as possible rather than to dispose of it. Rhode Island and New Jersey passed laws requiring separation of specific household recyclables. Massachusetts and Pennsylvania were considering enacting similar legislation. Michigan, New York, and Delaware were studying ways to approach their solid-waste problems. The full effect on the private wastepaper market will not be known until public recycling efforts become more widespread. Industry observers have forecasted different consequences. Some paperstock dealers will compete directly with the government for customers and markets. Others will form alliances with the government by providing processing and marketing expertise or simply by contracting to purchase the paper collected in the public program.

What impact it has on recyclable paper prices will depend on whether the government sells its stock at below-market prices, gives it away, or pays for its removal. Prices will probably be determined by whatever level is necessary to meet the costs of the recycling programs, according to Paul W. Rankin, director of state and local programs for the National Assn. of Recycling Industries.

WASTEPAPER IMPORTS INTO U.S. BY GRADE

(short tons)

	1987	1986	1985
Mixed papers	64,773	42,835	43,654
Printed news	29,757	31,291	28,862
Old corrugated	12,683	6,641	5,389
Pulp substitutes	1,834	2,777	2,999
High-grade deinking	18,313	15,769	6,559
Total	127,360	99,313	87,463

Source: Bureau of the Census data.

WASTEPAPER IMPORTS INTO U.S.

(short tons)

1987	127,398
1986	99,313
1985	87,463
1984	109,712
1983	100,410
1982	74,332
1981	79,064
1980	87,104
1979	78,395
1978	69,719
1977	91,013
1976	106,444
1975	71,963
1974	88,927
1973	86,804
1972	88,147
1971	68,244
1970	66,837

Source: Bureau of Census data.

CONVERTED PAPER AND BOARD PRODUCTS

The converting sector produces finished products—such as corrugated boxes, folding cartons, envelopes, and facial tissue—from paper and paperboard. The average converting plant is small, usually employing fewer than 100 persons and annually grossing about $10 million or less. However, the converting sector of the industry is not small. In fact, when sales of all converting segments are combined, they nearly equal the total value of all paper and board manufactured.

Because the converting sector is large and complex, this chapter can describe the subject only in a general way. In many cases, it is more practical to discuss converting under the primary manufacturing to which it relates; therefore, the reader is referred to sections covering primary paper or board grades for additional information.

The following converted paper and board products are discussed here or in other specified sections:

- Corrugated containers and solid fiber boxes (refer to Linerboard and Corrugating Medium sections)
- Setup paperboard boxes (refer to Recycled Paperboard section)
- Fiber and composite cans, tubes, and drums (refer to Recycled Paperboard section)
- Folding boxboard (refer to Recycled Paperboard section)
- Sanitary food containers (refer to Bleached Board section)
- Molded pulp products (refer to Molded Pulp Products section)
- Bags and sacks (refer to Packaging and Industrial Converting Papers section).

The following converted products, though not discussed in the text, are included in the statistical data in this section:

- Die-cut paperboard
- Paper coating and glazing
- Envelopes
- Stationery products
- Converted paper products, not classified.

While the printing and publishing industries are not converting industries, they are closely allied to the paper industry; data on these industries are summarized in the introduction to the Paper Grades section.

CORRUGATED CONTAINERS

Corrugated containers are the workhorses of the packaging industry. More goods and products are shipped in corrugated containers than in any other packaging system. Nearly 90%

PACKAGING SALES BY PACKAGING MATERIALS FOR 1987

	Shipments[1] ($ billion)	Percent of total
Total packaging sales	$66.8	100.0%
Paper and paperboard	27.7	41.5
Corrugated containers	14.5	21.7
Folding cartons	4.9	7.3
Paper bag/sacks	2.9	4.4
Sanitary food containers	3.2	4.8
Others	2.2	3.3
Metal	16.9	25.2
Cans	12.0	17.9
Drums and others	4.9	7.3
Other materials	22.2	33.3
Glass	5.3	7.9
Flexible	3.5	5.3
Plastic	6.8	10.2
Wood and textile	2.8	4.2
Others	3.8	5.7

1. Estimated 1987 value of products shipped, Bureau of Industry Economics, Census.

U.S. CONVERTED PRODUCTS INDUSTRY VALUE OF SHIPMENTS

($ million)

CONVERTED PAPER PRODUCTS

Year	Total	Sanitary paper products[1]	Bags and sacks[2]	Paper coating, glazing	Die-cut paper and board	Misc. converted products[3]	Envelopes	Stationery and tablets	Pressed and molded pulps
1986e	$32,248	$10,965	$5,954	$6,632	$1,939	$3,082	$2,270	$1,168	$238
1985	30,710	10,338	5,614	6,340	1,890	2,994	2,172	1,128	234
1984	29,925	9,772	5,388	6,452	1,880	2,928	2,108	1,161	236
1983	26,563	8,616	5,081	5,314	1,798	2,604	1,875	1,058	217
1982	25,044	8,374	4,773	4,903	1,605	2,436	1,752	959	242
1981	26,111	8,346	5,613	5,146	1,677	2,598	1,601	892	238
1980	23,705	7,636	5,215	4,688	1,454	2,187	1,464	836	225
1979	21,081	6,615	4,579	4,086	1,468	2,043	1,304	766	220
1978	18,447	5,591	3,926	3,746	1,189	1,901	1,121	747	226
1977	16,454	4,921	3,482	3,392	1,058	1,698	991	652	240
1976	12,558	4,187	1,936	2,653	983	1,267	843	510	219
1975	11,086	3,647	1,760	2,198	882	1,107	806	483	203
1974	9,886	3,041	1,913	2,350	884	1,073	813	486	202
1972	7,297	1,982	1,186	1,650	646	662	558	421	162

BOXES AND CONTAINERS

Year	Total	Corrugated containers[4]	Folding boxboard	Sanitary food containers	Fiber cans, tubes, drums	Setup paperboard boxes
1986e	$22,929	$13,335	$4,466	$2,982	$1,615	$531
1985	21,926	12,579	4,347	2,847	1,640	513
1984	21,968	12,719	4,327	2,750	1,679	493
1983	19,906	11,045	3,980	2,686	1,643	552
1982	18,578	10,303	3,744	2,556	1,490	485
1981	18,917	10,760	3,557	2,691	1,496	413
1980	17,193	9,651	3,277	2,430	1,370	465
1979	15,895	8,976	2,950	2,328	1,297	434
1978	14,528	8,030	2,884	2,086	1,119	409
1977	13,350	7,351	2,579	2,048	1,011	361
1976	11,662	6,530	2,162	1,744	1,000	406
1975	10,476	5,733	1,875	1,616	988	344
1974	10,489	5,867	1,807	1,506	909	400
1972	7,913	4,197	1,372	1,381	620	343

e = Estimate.

1. Includes drapes, sanitary napkins, tampons.
2. Includes plastic bags and sacks.
3. Includes wallcovering, gift wrap, industrial products, novelty items, etc.
4. Includes solid-fiber containers.

Source: Bureau of the Census.

of industrial and consumer goods transported in the U.S. are shipped in or with some form of corrugated or solid-fiber container, cushioning, or partition.

Corrugated containers are produced from two paperboard grades—linerboard and corrugating medium. Corrugated board is produced on a corrugator that simultaneously flutes the corrugating medium and bonds linerboard to the top and bottom of the medium. The corrugator also cuts the board to size and may score it in one direction. Before the blank can be formed into a box, score lines must be added in the other direction and slots must be cut to form flaps which can be folded. Printing of promotional information, specifications, and handling instructions must also be printed. The most common machine to perform these multiple steps is a flexo-slotter-folder-gluer.

The most common construction for corrugated board is single wall (one layer of medium between two layers of linerboard). About 90% of boxes in the U.S. are made from single-wall board. Corrugators can also produce single face (one layer of medium bonded to a single layer of liner) used mainly for wrapping and interior packing. Heavier-duty boxes can be made from double wall (two layers of medium and three linerboard facings) and triple wall (three medium and four liner facings). Five major types of flutes are formed—A, B, C, D, and E flutes. The choice of flute type is dependent primarily on strength (crush strength) and packaging requirements.

Corrugated boxes are manufactured in a number of different styles, the most common of which is the regular slotted container. More specialized types of boxes include bag-in-box for liquids and powdered products, bulk bins that can carry products weighing up to 3,000 lb, and trays for produce. Solid-fiber boxes, the first fiber boxes to replace wood packaging, are still used but account for only about 0.4% of industry shipments. Solid-fiber sheets are constructed by gluing or laminating two or more plies of paperboard together. A new and growing solid-fiber application is in slip sheets, replacing wooden pallets for forklift loads.

Freight classifications are publications maintained by the railroads and common motor carriers, and they include rules governing the acceptance of freight in transportation. Among other things, Railroad Rule 41 and Motor Carrier Item 222 establish (1) bursting strength of containerboard used to make a box and (2) weight of facings required for boxes used to carry different products. For example, a box that has 65-lb gross weight must have 84 lb/msf of facings, and two 42-lb facings would normally be used. Failure to comply with the classifications could subject the shipper to substantial penalities in the form of increased transportation charges, refusal of the shipment by the carrier, or rejection of payment for a freight claim.

Shipments and prices. Corrugated box shipments closely track U.S. industrial activity. Nondurable goods

U.S. PRICE INDEXES FOR MAJOR CLASSES OF CONVERTED PRODUCTS

(1982 = 100)

Year	Converted paper & paperboard products	Sanitary paper products and stock	Paper bags & shipping sacks	Paper boxes & containers	Composite cans
1987	114.7	109.1	125.9	115.4	117.0
1986	109.4	108.1	116.9	107.8	115.1
1985	108.9	106.6	111.9	108.8	114.7
1984	106.4	103.4	110.5	105.7	110.7
1983	100.4	102.1	99.0	99.5	106.5
1982	100.0	100.0	100.0	100.0	100.0
1981	97.9	98.2	n.a.	97.7	91.4
1980	90.2	91.9	93.6	89.4	84.9
1979	79.4	79.1	83.7	79.1	75.9
1978	70.5	71.7	72.5	69.9	70.3
1977	66.8	66.9	65.2	67.1	65.1
1976	64.3	60.6	62.1	66.0	60.0
1975	61.2	55.0	59.2	63.3	56.1
1974	54.8	44.0	52.6	58.5	48.1
1973	46.0	35.3	45.4	49.9	41.0
1972	43.0	34.2	40.9	46.4	38.8
1971	41.5	33.8	38.0	44.7	37.6
1970	40.8	32.5	40.6	43.3	36.3

n.a. = Not available.

Source: Bureau of Labor Statistics.

U.S. CORRUGATED BOX SHIPMENTS BY REGION

(billion ft²/year)

Year	Total	North-east	South-east	East Central	North Central	South Central	West
1987	297.8	54.3	54.8	43.7	35.7	58.5	50.7
1986	283.9	52.3	51.6	41.9	34.5	55.3	48.3
1985	267.5	50.1	48.0	40.3	32.7	52.1	44.3
1984	267.6	51.1	47.5	40.3	32.8	51.4	44.5
1983	252.5	50.3	44.1	37.2	31.3	47.4	42.2
1982	235.2	48.0	39.7	34.3	28.8	44.4	40.0
1981	246.2	50.1	41.7	37.6	30.0	45.2	41.6
1980	241.4	50.6	41.3	36.9	30.1	42.9	39.6
1979	250.6	53.3	41.6	41.1	31.8	43.2	39.7
1978	243.9	52.3	38.8	41.4	31.4	41.8	38.3
1977	227.2	48.3	35.2	39.8	29.6	38.6	35.6
1976	216.4	46.8	32.8	38.3	28.5	36.2	33.8

Source: Fibre Box Assn.

U.S. CORRUGATED PRODUCTION AND INVENTORY

	Production[1] (billion ft²)			Inventory[3]	
	Single wall	Double & triple wall	Total[2]	Tonnage (000 sh tons)	Weeks of supply
1987	289.4	27.6	317.0	2,237	6.0
1986	274.6	26.0	300.5	2,549	7.1
1985	258.9	24.5	283.4	2,882	8.4
1984	256.2	24.7	282.0	2,437	7.2
1983	240.3	22.7	264.2	2,584	8.9
1982	224.2	20.9	246.3	2,729	9.4
1981	229.8	22.1	253.0	1,984	6.2
1980	229.1	21.7	251.9	1,979	6.2
1979	236.7	23.2	261.1	1,961	5.8
1978	232.8	22.3	256.4	2,436	7.2
1977	217.2	20.4	238.8	2,527	8.1
1976	207.9	18.6	227.8	2,185	7.2
1975	186.2	15.9	203.2	2,323	8.2
1974	203.4	19.1	224.1	1,595	4.7
1973	216.8	20.2	238.5	1,603	5.1
1972	200.9	17.6	220.1	1,639	5.7
1971	183.8	15.1	200.3	1,879	7.0
1970	177.1	14.1	192.7	1,760	6.5

1. Production includes waste and trim before fabrication.
2. Total includes single-face production which has averaged around 1.3 to 1.5 billion square feet per year.
3. Inventory of linerboard, corrugating medium, and filler board at box plants and paperboard mills based on inventory at January 1 of each year.

Source: Fibre Box Assn.

account for about 70% of total shipments, with food and beverages the single largest end use. Corrugated box shipments in 1987 reached a record 297.8 billion ft², up 4.9% from the previous year. This followed a 6.1% increase in 1986. The industry began rebounding from the recession low of 235.2 billion ft² reached in 1982 with a jump of 7.3% in 1984, followed by another hike of 6.0% in 1985.

Corrugated box shipments over the past decade grew at about a 3% average annual rate. The fastest growth was in the Southeast, Southwest, and West, and the slowest growth was in the Northeast and Midwest, reflecting the movement of industry to the Sun Belt region. The Southeast's share of total U.S. box shipments increased from about 10.1% in 1960 to 18.4% in 1987, while the Northeast's share dropped from 27.3% to 18.2%. The East Central region also showed a major decline, with its share dropping from 21.4% in 1960 to 14.7% in 1987.

Corrugated prices over the past decade did not keep up with prices for other industrial products, resulting in pressure on industry profit margins. The Fibre Box Assn.'s corrugated price index between 1976-87, for example, rose

RANKING OF U.S. CORRUGATED CONTAINER PRODUCERS BY SHIPMENTS

	Number of U.S. plants	1987 shipments (billion ft²)
1. Stone Container	85	32.1
2. Smurfit/CCA	48	22.0
3. Weyerhaeuser	43	21.4
4. Temple-Inland	32	19.0*
5. International Paper	34	17.0*
6. Great Northern Nekoosa	25	16.5
7. Georgia-Pacific	30	15.8
8. Packaging Corp. of America	25	11.5*
9. Union Camp	24	11.5*
10. Willamette	19	11.1
11. Gaylord Container	21	9.5*
12. Boise Cascade	23	7.3

* *Pulp & Paper* estimates.

SUMMARY OF STATISTICS FOR CORRUGATED AND SOLID-FIBER BOX INDUSTRY

	Plants	Employees	Value of shipments ($ million)	Capital expenditures ($ million)
1987f	—	102,000	—	—
1986e	—	102,000	$13,335	—
1985	—	100,000	12,579	$420.3
1984	—	98,900	12,719	426.2
1983	—	96,900	11,045	248.1
1982	1,481	93,800	10,303	279.5
1981	—	97,300	10,760	271.2
1980	—	97,200	9,651	420.5
1979	—	103,700	8,976	303.0
1978	—	105,800	8,030	282.5
1977	1,472	101,500	7,351	243.3
1976	—	101,400	6,682	185.1
1975	—	94,700	5,821	207.9
1974	—	106,800	6,015	200.9
1973	—	109,700	5,230	125.0
1972	1,265	107,900	4,309	101.5
1971	—	102,700	3,668	87.5
1970	—	104,700	3,545	108.9
1969	—	105,600	3,500	161.9
1968	—	100,700	3,231	135.6
1967	568	97,100	2,960	127.7

Paperboard consumed (estimated):
1982: 18,306,800 short tons
1977: 17,272,100 short tons

f = Forecast.
e = Estimate.

Source: Bureau of the Census.

50.9%, while the Producer Price Index was up 68.1%. This was a substantial improvement from 1972-83, when FBA's index moved up just 43.2% compared with PPI's jump of 89.3%.

Industry structure. Corrugated containers are produced at two types of manufacturing plants—corrugated container plants (converting plants) and sheet plants. Both types of plants make corrugated container blanks, but only the corrugated container plant has a corrugator. Sheet plants purchase rolls or sheets of corrugated paperboard from corrugated container plants and cut and print these into container blanks.

In 1987, the number of plants in the U.S. was 1,576, of which 639 were converters and 937 were sheet plants. The number of sheet plants grew relative to the total because of the lower capital costs and technology required to build them. Nevertheless, sheet plants in 1987 accounted for only about 13.4% of total corrugated box shipments, compared

LARGEST CANADIAN CORRUGATED BOX PRODUCERS IN CAPACITY

	Number of Canadian plants	Annual capacity (million ft²)
MacMillan-Bathurst[1]	13	6,500
Domtar	13	5,620
Canadian Pacific	7	3,420
Atlantic Packaging	5	2,490
Paperboard Industries	5	2,180
Kruger	3	1,675

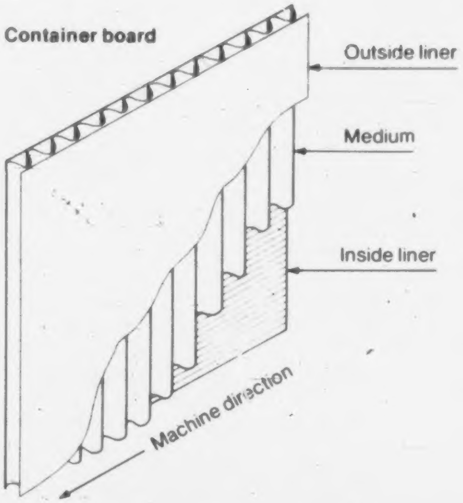
[1] Joint venture between MacMillan Bloedel Ltd. and Consolidated-Bathurst Inc.

Source: *Canadian Paper Analyst.*

COMMON FLUTES USED IN PRODUCTION OF CORRUGATED CONTAINERBOARD

	Number of flutes[1] per		Flute height[2]	
Flute	Lineal foot	Lineal meter	inch	mm
A	36	118	3/16	4.76
B	51	168	3/32	2.38
C	39-42	128-138	9/64	3.57
E	96	316	3/64	1.19

[1] Approximate
[2] Exclusive of liners



Source: *Metrication for the Pulp and Paper Industry,* Miller Freeman Publications with 11.7% in 1970.

The number of converting plants declined because of improved technology, which has increased the shipment volume per plant. The average converting plant in 1987 shipped 403 million ft^2 of corrugated containers, compared with an average of 262 million ft^2 in 1970.

The corrugated container industry is highly integrated with paperboard manufacturing. Integrated companies account for about 80% of total U.S. corrugated box shipments. Most sheet plants are owned by nonintegrated companies.

Unlike paperboard mills, corrugated container plants operate one to two shifts a day and generally on a five- to six-day week. The production units vary in size (with an average of 94 employees per converting plant and 10 employees per sheet plant), and they are located close to their markets, principally near large industrial and urban centers.

As noted earlier, lagging container prices have put the industry under significant cost pressure. This has forced container plants to improve productivity, and results have been dramatic. Shipments per week per employee rose from 46,600 ft^2 in 1970 to 84,000 ft^2 by 1987—an increase of 80%. The total number of employees in the industry declined over this period from 74,100 in 1970 to a low of 59,100 in 1982, but it started increasing again in 1983 and reached 69,500 in 1987. The dramatic improvement in productivity helped slow the industry's rise in unit labor costs. While total hourly payroll costs spiraled upward by 209% during this period, unit labor costs increased 68%, according to Fibre Box Assn. data.

New technology included the adoption of flexographic printing and the rotary die cutter in the 1960s, followed by the appearance of the continuous corrugator in the mid-1970s. New state-of-the-art continuous corrugators today can run at 800 to 1,000 fpm compared with about 600 fpm for a typical corrugator in the early 1970s.

Such high-speed machines make moisture uniformity, mechanical roll quality, and bonding speed of liners to medium increasingly important. Moisture variation in containerboard can cause warp that high-speed corrugators cannot tolerate, while roll defects may lead to costly downtime from web breaks. More U.S. containerboard manufacturers are showing an interest in meeting such uniform moisture requirements.

Changing market requirements. The trend toward stacking containers to greater heights on pallets in warehouses and for delivery has increased the demand for containers with greater top-to-bottom compression strength. This trend is being reinforced by a shift from rigid metal and glass containers to plastic flexible packaging in primary containers. At the same time, palletization has eliminated much of the manual handling of individual corrugated cases in the transportation system.

As a result, ring crush, which measures compression strength, is replacing bursting strength (mullen) as the most relevant performance requirement for corrugated board (see Linerboard section). A number of major containerboard producers have begun to market high-ring crush board that offers higher yield (more surface area per ton).

U.S. CORRUGATED BOX PRICE TRENDS

	BLS Corrugated shipping containers for food and beverages[1]	FBA National overall corrugated box price trend[2]	
	(Mar. 1980=100)	(1967=100)	($1,000 ft^2)
1987	128.4	255.9	$42.94
1986	116.6	229.4	38.48
1985	119.3	239.7	40.22
1984	115.5	242.3	40.75
1983	106.8	219.5	36.85
1982	108.7	225.9	37.92
1981	108.1	230.0	38.61
1980	100.9	212.8	35.73
1979	n.a.	188.9	31.71
1978	n.a.	168.1	28.23
1977	n.a.	168.2	28.24
1976	n.a.	169.6	28.46
1975	n.a.	165.5	25.79
1974	n.a.	153.2	25.91
1973	n.a.	122.5	20.56
1972	n.a.	107.4	18.03
1971	n.a.	104.2	17.49

Source: 1. Bureau of Labor Statistics. 2. Fibre Box Assn.

SUMMARY OF SHIPMENTS IN 1987 OF CORRUGATED CONTAINERS BY END USE INDUSTRY

	Percent of total sq. footage
1. Food and similar products	36.2%
2. Paper and allied products	16.8
3. Stone, clay, glass products	7.1
4. Rubber & misc. plastic products	6.5
5. Chemical and allied products	6.3
6. Misc. manufacturing products	5.3
7. Electrical machinery	3.7
8. Fabricated metal products	2.6
9. Furniture and fixtures	2.6
10. Textile mill products	2.0
11. Machinery, except electrical	1.8
12. Printing, publishing & allied industries	1.5
13. Apparel and fabrics	1.4
14. Transportation equipment	1.4
15. Lumber and wood products	1.2

Source: Fibre Box Assn. 1987 annual report.

CORRUGATED AND SOLID FIBER BOX SPECIFICATIONS FOR RAILROAD (RULE 41)

		Corrugated fiberboard							
		Single wall		Double wall		Triple wall		Solid fiberboard	
Maximum weight of box and contents lb	Maximum inside dimensions (length, width and depth added) in.	Minimum inside combined weight of facings lb/1,000 ft²	Minimum bursting test of combined board psi	Minimum combined weight of facings including center facing lb/1,000 ft²	Minimum bursting test of combined board psi	Minimum combined weight of facings including center facing lb/1,000 ft²	Minimum puncture test of combined board in.-oz./in.-tear	Minimum combined weight of component plies (exclusive of adhesives) lb/1,000 ft²	Minimum bursting test of combined board psi
20	40	52	125	—	—	—	—	114	125
30	50	66	150	—	—	—	—	—	—
40	60	75	175	—	—	—	—	149	175
65	75	75	200	92	200	—	—	190	200
90	90	138	275	110	275	—	—	237	275
120	100	180	350	126	350	—	—	283	350
140	110	—	—	222	500	—	—	330	500
160	120	—	—	270	600	—	—	360	600
275	120	—	—	—	—	264	1,100	—	—

Both the new emphasis on compression strength and the need to reduce fiber costs were behind an industry proposal several years ago for an alternate to Rule 41. However, few permits were taken out to test the proposed alternate rule, which measures box construction on the basis of the edge-crush or short-column test. Although the new rule seemed feasible in the limited trials that were conducted, there was little economic incentive to go through the changes of procedure, according to William O. Kroeschell, vice president of product technology, Stone Container Corp. Nevertheless, an increasing number of mills, converting plants, and end users are measuring and specifying their board and finished boxes in terms of compression strength.

One interesting method of achieving high compression strength is through chemical saturation of containerboard. This has become feasible through development of new types of saturators using such chemicals as sodium silicate and urea formaldehyde, which can also provide boxes with improved fire and humidity resistance. International Paper Co. (Anvil Box) and a number of other companies have begun to offer such chemically enhanced products. Some companies such as Nekoosa Packaging (Duo Corr) are offering a double-laminated corrugating medium that offers substantially more crush resistance, bursting strength, and higher ring crush. Single-wall boxes with the double-laminated medium can be substituted for bulkier, expensive double-wall boxes. Laminating is done at the corrugator using polyvinyl acetate adhesive.

Another trend is toward increased emphasis on the graphic quality of corrugated containers. The corrugated box is increasingly serving not only as a shipping container, but also as point-of-purchase display in self-service mass merchandise stores. During the 1980s, 17 flexographic presses have been installed by 14 companies in North America to preprint linerboard. Such preprinted linerboard offers higher-quality graphics than can be achieved by conventional postprinting of corrugated board, and it is less expensive than the higher-quality process of litho-laminating labels.

L.C. Schiffenhaus Jr., vice president of Schiffenhaus Inc., recently estimated that preprint now represents about 5 billion ft^2—or close to 2%—of the total 290-billion-ft^2 U.S. corrugated market. Nevertheless, only a portion of existing preprint capacity is being utilized, for he estimated that total U.S. preprint capacity is about 13.5 billion ft^2 with another 2.5 billion ft^2 in Canada. Volume is expected to grow as major packagers of consumer goods shift to higher-quality preprint packaging, spurring other companies in the industry to make the same move.

The growth of preprinting will also be helped by the development of more cost-effective board substrates in North America, such as white-top linerboard being introduced by Chesapeake Corp. The main substrates currently being used for preprinting include coated kraft board, solid bleached linerboard, and mottled/unbleached linerboard (see Linerboard section).

Most major U.S. integrated producers now have preprint operations, including Jefferson Smurfit/CCA, International Paper Co., MacMillan Bloedel, Menasha Corp., Nekoosa Packaging Corp., Stone Container Corp., Union Camp Corp., Willamette Inc., Westvaco Corp., and Weyerhaeuser

FOLDING PAPERBOARD BOX SHIPMENTS BY END USE

(million $)

	1986	1982	1977
Wet food and frozen (including ice cream)	$119.80	$104.80	$80.80
Dry food and produce (including pet food)	573.00	544.20	376.40
Bottled and canned beverages (including carriers)	392.70	375.00	232.00
Soaps & detergents	187.20	205.50	143.80
Tobacco	133.10	131.70	93.70
Hardware, household supplied	181.70	183.10	166.60
Candy	121.50	111.40	78.80
Cosmetics and medicine	396.40	380.10	236.00
Paper goods (including book mailers)	257.80	191.90	127.20
Retail food carryout (boxes and trays)	188.10	114.80	77.00
All other uses	836.70	719.30	546.60
Miscellaneous	80.00	67.20	68.10
Total	$3,468.00	$3,129.00	$2,227.00

Source: Paperboard Packaging Council.

Co. Independent converters with preprint operations include Schiffenhaus (U.S. and Canada), Lux Packaging Co., Pioneer Container Corp., and Southern Container Corp. Most litho-laminated containers are produced by independent converters such as Rand Whitney Container Corp. and Schiffenhaus.

Future outlook. A 2.5% average annual growth rate is forecasted for corrugated containers during 1987-91, about the same rate as the rise in containerboard capacity, according to the Dept. of Commerce. Plastics will continue to make some inroads into traditional corrugated markets, perhaps at the rate of 1% annually or less during the period. However, containerboard producers and users will continue to hold their own by diversifying into new and existing market areas.

Principal market growth is expected in shipping containers and displays for paper and allied products, chemical and allied products, plastics, and electrical machinery and equipment. Industry growth will feature continued development and use of preprinted linerboard; increased use of flexography in color printing; further improvements in graphic design; continued growth of computerization and automation in all phases of box plant operations; better marketing and distribution methods; modifications of existing box specifications for compression and burst strength; increased emphasis on high-strength boxes for stacking; increased use of laminated board; improved coatings, adhesives, and inks; and greater use of E-Flute board in point-of-purchase displays of shipping containers.

U.S. PRODUCTION OF UNBLEACHED KRAFT AND RECYCLED PAPERBOARD FOR TUBE, CAN, AND DRUM STOCKS

(000 short tons)[1]

Year	Kraft	Recycled
1986	54	1,043
1985	64	1,021
1984	74	1,038
1983	99	858
1982	151	767
1981	334	808
1980	220	564
1979	232	628
1978	202	602
1977	180	680
1976	172	702
1975	145	631
1974	213	733
1973	215	763
1972	216	728
1971	159	642
1970	194	573
1969	180	527

1. Some bleached kraft paperboard is also produced for these uses, but is not included in these data.

Source: Bureau of the Census.

END USES FOR RIGID PAPER BOXES

(Percentage distribution)

	1981	1980	1978	1976	1974	1970
Textile, apparel, hosiery	5.5%	4.4%	7.3%	3.7%	4.9%	18.9%
Department stores and specialty shops	7.1	6.8	10.1	10.7	10.1	13.1
Cosmetics and soaps	3.9	5.5	3.3	5.3	3.9	6.2
Confections	18.0	12.6	9.0	10.5	9.8	7.9
Stationery and office supplies	9.3	13.5	11.8	12.5	10.4	8.2
Jewelry and silverware	9.7	9.3	10.7	4.2	8.6	3.2
Photographic	4.3	4.5	3.0	2.4	3.2	2.6
Shoe and leather	0.2	0.3	3.7	1.3	7.5	4.4
Drugs, chemical, pharmaceuticals	7.8	7.5	4.9	9.3	7.8	4.2
Toys and games	1.8	1.4	2.1	3.3	1.1	7.0
Hardware & household supplies	4.0	5.5	5.4	6.4	7.7	4.9
Food, beverages	3.9	4.3	2.9	3.6	1.2	0.8
Sporting goods	1.2	1.2	1.2	0.7	1.4	2.6
Electronics	3.5	3.6	2.9	4.2	2.3	—[1]
Educational	4.4	3.7	5.2	3.9	4.8	—[1]
Other and miscellaneous customers	15.4	15.9	16.5	18.0	15.3	9.6

1. Listed under other and miscellaneous customers.

Source: National Paperbox & Packaging Assn.

Despite high transportation costs, significant real growth is expected in U.S. exports of corrugated products, especially to Canada, Mexico, and the Caribbean Basin. A number of box plants are being established on both sides of the border to serve Mexico's growing Maquiladora industry.

FOLDING PAPERBOARD BOXES

This paperboard possesses strength qualities that permit scoring and folding, with variable surface properties depending upon the printing requirements. It is suitable for the manufacture of folding cartons, and it can be made from a large variety of raw materials on either a cylinder machine or a fourdrinier machine. According to industry statistics, recycled clay-coated board garnered a 44.3% share of this market in 1986, while solid bleached sulfate paperboard held 38.5% and unbleached kraft moved up to a 17.2% share.

Domestic folding carton shipments generally follow consumer spending and real disposable income levels, although box sales have often lagged slightly behind fluctuations in the nation's economic growth. Folding cartons shipments grew only about 1% compounded annually between 1972 and 1986. Part of the problem was due to changes in product mix and use of less dense boxboard in the manufacturing process, according to the Dept. of Commerce.

Folding carton volume also suffered as a result of competition from such alternatives as flexible packaging, rigid plastic containers, and corrugated board—all of which have made inroads into some traditional folding carton markets during the past decade. However, the folding carton industry rebounded somewhat with growth in new and existing end uses, especially those that are food-related.

Folding carton shipments totaled about 2.9 million short tons in 1986, a jump of 2.6% from the preceding year, according to the Dept. of Commerce. This followed a 1% drop in shipments in 1985. The record 1986 shipments were attributed primarily to the rise in packaging demand from the food and beverage sector. This sector accounted for about 55% of the value of the tonnage of folding cartons shipped in 1985, and it has provided about a 5% average annual rate of growth for the folding paperboard box industry, according to the Dept. of Commerce.

The strong performance in 1986 also resulted from some renewed strength in sales of packaged nondurables, the major end-use market for the industry. Several nondurable end-use markets such as beverage carriers and sporting goods, candy, soap, paper goods, and other retail items are estimated to have expanded, while the folding carton market for tobacco, medicinal products, cosmetics, and hardware probably experienced some decline.

In recent years, there has been a trend to use less clay-coated recycled board and more nonrecycled grades, especially unbleached kraft, according to the Dept. of Commerce (see related chapters on recycled board and bleached board). Dept. of Commerce figures indicate that 52% of folding cartons produced in 1986 were made from nonrecycled grades of boxboard, up from 51% in 1985. Consumption of solid bleached sulfate remained weak at about 35%, but greater use of unbleached kraft grades more than compensated for the loss. At the same time, the darker grades of recycled board grew at the expense of clay-coated

FIBER CANS, DRUMS AND SIMILAR PRODUCTS: SHIPMENTS AND TONNAGE BY TYPE

	1982	1977	1972
Fiber drums			
Product shipments, $ million	289.8	223.8	136.9
Paper & board consumed, 000 tons	137.4	149.4	160.1
Fiber and composite cans			
Product shipments, $ million	701.1	469.0	253.2
Paper & board consumed, 000 tons	212.5	210.9	216.1
Cores and tubes			
Product shipments, $ million	340.9	263.4	164.3
Paper & board consumed, 000 tons	746.6	638.7	624.5
Paperboard cores, reels[1]			
Product shipments, $ million	46.5	36.7	31.0
Paper & board consumed, 000 tons	41.0	63.5	79.1
Vulcanized fiber products[2]			
Product shipments, $ million	n.a.	6.6	14.0
Paper & board consumed, 000 tons	25.4	n.a.	34.3
Other, not specified			
Product shipments, $ million	105.8	40.8	20.0

1. Includes spools, bobbins, and blocks.
2. Includes boxes, cans, tubes, drums.

Source: Bureau of the Census.

board, which comprised about 38% of the boxboard consumed in 1986.

The folding carton industry was expected to grow about 2% to approximately three million tons in 1987, the Dept. of Commerce estimated. For the long term, shipments should increase by about 1.5% annually during the 1987-91 period. Manufacturers are expected to continue to emphasize improved package design and graphics and tamper-resistant technology.

Productivity improvements should result from better cutting and creasing equipment, higher-speed box manufacturing machinery and printing presses, better coating and gluing equipment, and infrared ink-curing systems. In addition, continued improvement in automation and computerization in manufacturing, marketing, and distribution should also boost productivity.

The growth in the proportion of single-person households will result in more opportunities in fast foods, convenience foods, and single-portion meals.

SETUP PAPERBOARD BOXES

Also called nonbending paperboard, these are containers in rigid form, as compared to a folding or collapsible box. They can be made from solid or combination board depending on the style of the container. They range in thickness from 0.016 to 0.065 in. and weigh 60 to 260 lb/1,000 ft^2.

Stiffness, rigidity, and resistance to abuse are essential qualities. Rigid boxboard can be laminated or pasted together to form nonbending boards of greater thicknesses. It can be made from plain chipboard, filled newsboard,

STATISTICAL SUMMARIES (BASED ON DATA FROM CENSUS BUREAU)

PAPER COATING & GLAZING (SIC Code 2641)

	Plants	Employees	Value of shipments ($ million)	Capital expenditures ($ million)
1987f	—	42,600	—	—
1986e	—	42,600	$6,494	—
1985	—	42,500	6,190	—
1984	—	42,000	6,301	$197.0
1983	—	41,000	5,703	177.0
1982	579	43,100	5,454	201.0
1981	—	42,200	5,146	200.0
1980	—	45,800	4,688	175.0
1979	—	49,800	4,230	151.0
1978	—	41,300	3,746	91.0
1977	529	39,700	3,392	99.0
1976	—	39,300	3,074	92.0
1975	—	36,600	2,626	108.0
1974	—	40,800	2,645	84.0
1973	—	39,300	2,285	70.0
1972	426	37,200	1,954	52.0
1971	—	38,400	1,832	42.0
1970	—	38,300	1,750	77.0

Paper consumed (estimated):
1982: n.a.
1977: 1,562,200 short tons
1972: 1,352,000 short tons

ENVELOPES (SIC Code 2642)

	Plants	Employees	Value of shipments ($ million)	Capital expenditures ($ million)
1987f	—	26,600	—	—
1986e	—	26,300	$2,336	—
1985	—	25,800	2,235	—
1984	—	25,100	2,169	—
1983	—	24,700	1,912	—
1982	299	25,100	1,799	$46.2
1981	—	25,600	1,601	38.1
1980	—	25,600	1,460	55.2
1979	—	24,900	1,304	38.7
1978	—	22,900	1,121	29.3
1977	265	22,600	991	22.9
1976	—	21,700	870	22.7
1975	—	21,900	830	19.1
1974	—	24,300	868	19.2
1973	—	23,300	690	21.1
1972	247	22,900	621	17.4
1971	—	22,400	573	23.1
1970	—	23,400	574	21.6

Paper consumed (estimated)[1]:
1977: 677,000 short tons
1982: 845,000 (797,000 purchased in open market)
1972: 695,000 short tons
Number envelopes produced:
1982: n.a.
1977: 97,889 million
1972: 96,599 million

1. An estimated 13,000 tons of paperboard included for 1977 and 29,000 for 1972.

f = Forecast. e = Estimate. n.a. = Not available.

Source: Bureau of the Census.

single new vat-lined chipboard, or single white vat-lined chipboard. Setup paperboard is usually made from a cheaper grade of wastepaper than folding cartons because it is not subject to scoring and bending.

After a decline in shipments of more than 5% annually between 1962 and 1982, the industry grew a modest 1.5% in both 1985 and 1986. The approximately 500 setup box production facilities operating in the early 1960s dwindled to about 175 to 180 firms by 1986. At the same time, employment fell by almost half from about 20,500 in 1962 to 10,600 in 1982. The low point was reached in 1984, when just 9,300 people were working, and then the industry rebounded to about 9,700 in 1986.

Since the early 1980s, the industry has largely halted its downward spiral. Subsequent fluctuating growth patterns have been attributed mainly to U.S. economic trends and changing consumer disposable income and spending levels. The industry has improved its competitive position through a restructuring involving mergers and acquisitions in recent years, as well as improvements in cost effectiveness and productivity, diversification of its product mix, and entry into new market areas.

Some have added folding carton plants and paperboard/plastic combinations and laminations to their product lines. In addition, new technology has enabled the industry to expand into packaging for computer software, video equipment, food and beverages, advertising specialties, stationery and office supplies, cosmetics and soaps, jewelry, confectionery, chemicals, drugs, and other products previously dominated by other packing mediums.

STATISTICAL SUMMARIES (BASED ON DATA FROM CENSUS BUREAU)

BAGS, EXCEPT TEXTILE BAGS[1] (SIC Code 2643)

	Plants	Employees	Value of shipments ($ million)	Capital expenditures ($ million)
1987f	—	52,200	—	—
1986e	—	50,800	$6,292	—
1985	—	49,300	5,932	—
1984	—	49,100	5,698	$174.0
1983	—	50,300	5,293	150.0
1982	575	50,200	5,038	141.0
1981	—	54,700	5,613	165.7
1980	—	54,900	5,215	163.6
1979	—	52,700	4,579	129.7
1978	—	49,500	3,926	135.1
1977	596	48,700	3,482	93.4
1976	—	50,700	3,380	93.9
1975	—	48,800	2,980	94.5
1974	—	51,600	2,867	65.5
1973	—	49,500	2,183	51.8
1972	583	48,600	1,886	53.9
1971	—	50,300	1,772	94.9
1970	—	53,200	1,711	81.4

Paper consumed (estimated):
1982: 3,279,999 short tons (1,874,000 tons is purchased on the open market)
1977: 3,178,000 short tons
1972: 2,616,000 short tons

DIE-CUT PAPER AND BOARD (SIC Code 2645)

	Plants	Employees	Value of shipments ($ million)	Capital expenditures ($ million)
1987f	—	17,600	—	—
1986e	—	17,500	$1,922	—
1985	—	17,200	1,942	—
1984	—	17,500	1,931	—
1983	—	15,600	1,770	—
1982	396	15,700	1,676	$32.7
1981	—	17,200	1,677	23.2
1980	—	16,600	1,454	41.0
1979	—	17,000	1,468	32.7
1978	—	15,100	1,189	26.4
1977	371	14,300	1,058	15.3
1976	—	15,300	1,027	28.6
1975	—	14,800	943	17.1
1974	—	16,500	923	23.3
1973	—	15,900	747	12.9
1972	374	15,200	676	10.6
1971	—	17,300	612	17.8
1970	—	18,200	612	17.8

Paper and paperboard consumed (estimated)
1982: 353,000 short tons
1972: 2,616,000 short tons
1977: 259,000 short tons
1972: 510,000 short tons
Paperboard
1982: 982,100
1977: 927,000 short tons
1972: 953,000 short tons

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[1] Includes polyethylene bags and sacks.
f = Forecast. e = Estimate.

Source: Bureau of the Census.

The industry, however, is concerned about the rising quantity of prepackaged foreign goods flowing into the U.S., obviating the need for domestic packaging mediums.

The real value of setup boxes is expected to rise by an annual compounded rate of 1.5% during 1987-91, provided the industry continues to adapt its packaging products to new high-value, packaged nondurable goods. Setup boxes will be challenged by folding cartons and plastics in some of their traditional markets, but they are expected to retain their share in high-value, specialty packaging. Growth markets are expected to include packaging for cosmetics, pharmaceuticals, confectionery, and electronics.

FIBER CANS, DRUMS, AND TUBES

Composite cans, tubes, and cores are produced by the spiral or convoluted winding of paperboard strips around a core or mandel. The paperboard can be recycled board, kraft paperboard, or semichemical board. Strength is produced by the use of two or more plies. If special barriers are required, the board is first laminated with plastics or foil, or coated with hotmelts and other specialty coatings. An adhesive such as dextrine is applied to the strips during winding. The endless formed tube is cut on a mandel to desired sizes. For composite cans, either metal or plastic caps are used to seal the ends.

Composite cans are used to package a number of food and nonfood items such as frozen fruit juices, motor oils, snack foods, and adhesives.

The market has matured in the 1980s, mainly because composite cans have not been able to penetrate new high-volume packaging areas, such as what occurred in the 1960s for motor oil and juices.

The motor oil segment of the market has come under increasing competitive pressure from plastic bottles, while composite can markets are being eroded by plastic containers. In 1986, shipments of composite quart cans for motor oil declined an estimated 20% in volume—about the same rate as in 1985.

Sales of composite cans for juice-drink concentrates also fell during the 1985-86 period, dropping an estimated 4.5% in volume (compared with an 8.5% loss for the 1984-85 period). Plastic cans, flexible plastic pouches, aseptic containers, as well as paperboard, metal, and glass

STATISTICAL SUMMARIES (BASED ON DATA FROM CENSUS BUREAU)

SANITARY PAPER PRODUCTS (SIC Code 2647)

	Plants	Employees	Value of shipments ($ million)	Capital expenditures ($ million)
1987f	—	40,300	—	—
1986e	—	39,500	$11,474	—
1985	—	38,800	10,872	—
1984	—	38,100	10,327	$313.0
1983	—	36,700	9,240	373.0
1982	137	36,700	9,086	270.9
1981	—	36,600	8,346	248.2
1980	—	37,700	7,636	250.9
1979	—	37,700	6,615	265.4
1978	—	35,000	5,591	210.6
1977	120	34,500	4,921	199.1
1976	—	32,900	4,410	108.4
1975	—	31,400	3,884	121.2
1974	—	31,300	3,265	65.2
1973	—	28,200	2,325	109.0
1972	108	26,300	2,072	119.6
1971	—	24,000	1,716	52.9
1970	—	24,600	1,654	50.5

Paper consumed (estimated):
1982: 3,589,000 short tons (383,000 purchased on open market)
1977: 3,651,000 short tons

f = Forecast. e = Estimate.

Source: Bureau of the Census.

STATIONERY PRODUCTS (SIC Code 2648)

	Plants	Employees	Value of shipments ($ million)	Capital expenditures ($ million)
1987f	—	13,700	—	—
1986e	—	13,500	$1,180	—
1985	—	13,300	1,139	—
1984	—	13,600	1,173	—
1983	—	12,700	1,093	—
1982	216	12,700	1,035	$21.5
1981	—	11,900	892	13.1
1980	—	13,000	836	12.7
1979	—	13,400	766	14.6
1978	—	13,900	747	18.4
1977	242	12,600	652	15.9
1976	—	12,300	653	12.7
1975	—	12,100	591	15.5
1974	—	13,300	605	8.0
1973	—	15,000	493	6.5
1972	431	14,700	450	9.3

Paper consumed (estimated):
1982: 422,000 (337 short tons purchased on open market)
1977: 470,000 short tons
1972: 511,000 short tons

containers provided increasing competition for composite frozen juice and drink cans during the last few years.

Composite tubes and cores shipments rose 3.5% in 1986, buoyed by increased shipments of cloth and yarn cores and paper mill tubes. Tubes and cores have comprised about 30% of industry shipments in recent years. The industry's fiber drum sector has shown surprising growth in recent years. Estimated value of drum shipments was up in 1986, largely at the expense of metal drums but also due to moderate demand growth by the industrial sector. Drum shipments in 1986 comprised about 20% of total industry sales.

STATISTICAL SUMMARIES (BASED ON DATA FROM CENSUS BUREAU)

MISCELLANEOUS CONVERTED PRODUCTS (SIC Code 2649)

	Plants	Employees	Value of shipments ($ million)	Capital expenditures ($ million)
1987f	—	28,800	—	—
1986e	—	28,700	$3,116	—
1985	—	28,500	3,026	—
1984	—	28,600	2,960	—
1983	—	27,100	2,496	—
1982	776	27,200	2,384	$68.9
1981	—	30,100	2,598	55.4
1980	—	30,800	2,329	66.3
1979	—	30,100	2,043	86.3
1978	—	30,100	1,901	77.6
1977	833	29,400	1,698	51.1
1976	—	22,800	1,288	25.4
1975	—	21,700	1,090	29.6
1974	—	24,000	1,079	37.7
1973	—	22,000	833	25.4
1972	307	18,100	631	18.5

Paper and paperboard consumed (estimated):
Paper
1982: 514,300 short tons
1977: 424,000 short tons
1972: 495,000 short tons
Paperboard
1982: n.a.
1977: 169,000 short tons
1972: 112,000 short tons

FOLDING PAPERBOARD BOXES (SIC Code 2651)

	Plants	Employees	Value of shipments ($ million)	Capital expenditures ($ million)
1987f	—	36,400	—	—
1986e	—	36,200	$4,560	—
1985	—	36,000	4,447	—
1984	—	35,600	4,421	$131.0
1983	—	42,600	3,967	94.3
1982	564	43,700	3,902	105.0
1981	—	44,300	3,557	101.0
1980	—	45,500	3,277	92.2
1979	—	45,000	2,950	76.8
1978	—	45,600	2,884	100.0
1977	574	44,700	2,579	80.8
1976	—	40,600	2,233	65.2
1975	—	38,300	1,952	67.0
1974	—	43,200	1,890	60.0
1973	—	45,300	1,644	41.8
1972	544	45,300	1,487	37.4
1971	—	44,900	1,366	33.7
1970	—	48,700	1,387	49.9

Paper consumed (estimated):
1982: 3,124,000 short tons (of which 1,744,800 purchased on the open market)
1982: 3,143,000 short tons (of which 1,764,000 purchased on the open market)

f = Forecast. e = Estimate. n.a. = Not available.

Source: Bureau of the Census.

STATISTICAL SUMMARIES (BASED ON DATA FROM CENSUS BUREAU)

	Plants	Employees	Value of shipments ($ million)	Capital expenditures ($ million)
FIBER CANS, DRUMS, AND SIMILAR PRODUCTS (SIC Code 2652)				
1987f	—	13,300	—	—
1986e	—	13,400	$1,639	—
1985	—	13,500	1,657	—
1984	—	13,900	1,692	$41.1
1983	—	14,100	1,828	35.0
1982	304	14,100	1,474	31.1
1981	—	16,200	1,496	37.3
1980	—	15,900	1,370	42.9
1979	—	17,100	1,297	31.2
1978	—	16,300	1,119	23.6
1977	309	16,100	1,011	26.7
1976	—	16,600	936	26.6
1975	—	16,900	837	27.5
1974	—	19,600	828	30.5
1973	—	18,200	673	16.8
1972	282	17,300	568	17.9
1971	—	16,200	495	16.4
1970	—	16,500	465	16.1
1969	—	16,400	445	16.8
SETUP PAPERBOARD BOXES (SIC Code 2655)				
1987f	—	9,900	—	—
1986e	—	9,700	$502	—
1985	—	9,500	485	—
1984	—	9,300	466	$18.0
1983	—	12,300	569	14.1
1982	261	10,600	433	10.0
1981	—	13,700	511	18.6
1980	—	13,500	465	16.2
1979	—	13,400	434	14.6
1978	—	13,700	409	17.6
1977	312	13,100	361	8.8
1976	—	15,500	402	4.6
1975	—	14,500	350	15.1
1974	—	18,300	387	5.6
1973	—	16,000	320	5.7
1972	395	18,100	321	6.4
1971	—	19,700	332	8.5
1970	—	22,000	326	12.0

Paperboard consumed (estimated):
1982: 196,400 short tons (188,000 from open market)
1977: n.a.

f = Forecast. e = Estimate. n.a. = Not available.

Source: Bureau of the Census.

BAGS (EXCEPT TEXTILE): SHIPMENT AND TONNAGE BY TYPE

	1982	1977
Grocers bags and sacks		
Product shipments, $ million	917.1	612.6
Paper consumed, 000 tons	1,913.1	1,699.0
Variety (merchandise) bags		
Product shipments, $ million	152.6	139.7
Paper consumed, 000 tons	212.8	255.1
Shopping bags (uncoated)		
Product shipments, $ million	37.4	33.2
Paper consumed, 000 tons	30.0	42.0
Other paper bags		
Product shipments, $ million	56.8	12.3
Paper consumed, 000 tons	56.1	21.9
Specialty bags & liners (coated)		
Product shipments, $ millon	200.3	210.6
Paper consumed, 000 tons	148.9	n.a.
Shipping sacks (single and multiwall)		
Product shipments, $ million	846.5	658.8
Paper consumed, 000 tons	925.3	997.6

Note: Polyethylene grocery and variety bag tonnage was estimated at 133,000 tons valued at $267.8 million in 1982. Plastic shipping sack: 22,000 tons valued at $38.6 million.

Source: Bureau of the Census.

SHIPPING SACK END-USE MARKETS

(millions of sacks)

End use	1987	1984	1980
Seeds	149	189	179
Sugar	63	63	71
Dog and cat food	244	211	194
Flour and flour mix	154	140	136
Livestock and poultry feed	407	446	499
Cement and mortar mix	222	169	112
Portland cement	96	101	109
Masonry cement	70	84	82
Insulation	23	52	89
Fertilizer	143	170	221
Plastic materials	123	132	144
Chemicals	294	333	332
Absorbents	102	91	58
Clays	118	151	163
Limestone	104	124	123
Salt and water softeners	116	126	128
Other	856	807	827
Total	3,284	3,389	3,467

Source: Paper Shipping Sack Manufacturers Assn.

MOLDED PULP PRODUCTS

Molded pulp products are converted products, the smallest of the domestic paper and converting sectors, says the Bureau of Industrial Economics (BIE). The product is made in a unique wet-forming process invented around the turn of the century.

Molded products are mostly used for single food service use, including: egg cartons, plates, dishes, prepackaging trays, meat boards, and other food trays (such as entrée/drink holders in fast-food restaurants), various papier-mâché articles, and fiber pipe, conduit, and fittings, according to the Dept. of Commerce.

The number of molded pulp producers has remained relatively small, with 85% to 90% of the industry's capacity held by just four producers. The number of North American molded and processed pulp manufacturing sites, including those in Mexico, has dropped by more than half over the past 15 years to about 22 facilities (about 16 companies) in 1988, down from 31 in 1982 and 49 in 1972.

Molded pulp products are made directly from pulp. Fibers are drawn from a liquid slurry onto preformed molds by either vacuum suction or cloth covers that catch the fibers. The maximum possible amount of water—usually 25% to 30%—is first removed mechanically, then the molded pulp is either passed through heated tunnels or pressed between heated dies. Molding, pressing, and drying are done in a continuous process.

The furnish is short-fibered, derived usually from clean grades of wastepaper, although groundwood and hardwood sulfate pulps also are used. The secondary fiber or market pulp is first made into a slurry in a conventional pulper, refined, sized, and then formed.

MARKETS

Molded pulp products are classified into five categories, including: (1) consumer, (2) food service, (3) retail food packaging, (4) food distribution, and (5) specialty products. These items should not be confused with solid bleached paperboard products, called pressed board, which are machine-stamped or pressed into a form such as a dish or tray (see chapter on solid bleached paperboard).

The primary market for molded pulp products is in the consumer sector. Retail food packaging (particularly egg cartons) and food distribution (especially egg trays and fruit packaging trays) are also major markets for molded pulp products.

Consumer products such as disposable tableware (cups, plates, and bowls) are sold in retail stores directly to the consumer. Pressed paperboard reportedly dominates this market, with molded pulp products having the second largest share, but plastic is "making obvious inroads," according to one industry observer.

During the 1970s, competition from plastics cost the pulp and paper industry significant losses in a number of traditional paper markets, including food prepackaging trays (especially meat and fresh produce), egg cartons, and fiber

TYPICAL MOLDED PULP PRODUCTS BY END USE

Consumer products
- Tableware
- Plates
- Dishes

Food service
- Plates
- Trays (bottle, food, etc.)
- Carry-out containers

Food distributors
- Egg cases
- Egg trays
- Fruit packs

Food packaging
- Egg cartons
- Meat trays
- Poultry trays
- Cake circles

Specialty
- Florist vases
- Flower pots
- Seed pots
- Interior packaging
- Minnow buckets

pipe. Plastic foam now dominates the egg carton market. It is not known how much of the meat and produce tray business has been lost to plastics, but molded pulp is believed to be used more often with meat and poultry because it absorbs some of the liquids. Bituminous fiber pipe for uses such as sewer and drainage pipe, conduit, and fittings has been almost totally displaced by plastics, according to observers.

But Dept. of Commerce analyst Gary Stanley says in the 1987 Industrial Outlook that in 1984, "after a decade of steady decline in sales, real shipments of molded pulp goods increased 2.5% and prices rose 7%. Following a slight decrease in sales in 1985, the industry rebounded in 1986, and the value of molded pulp product shipments reached an estimated $238 million—the highest level since 1981. This represented a 1.5% price-adjusted rate of growth," he said.

Packaging products (egg cartons, meat trays, and the like) accounted for nearly 70%—$198 million—of all pressed and molded pulp products shipments in 1987. "The remaining sales [$84 million] consisted primarily of specialty fiber pipe and tubes, single-service trays and plates, and various box cushions and partitions," Stanley explained.

Molded pulp shipping trays are sold to food distributors for packaging fragile products such as eggs and fruits so they will not be broken or bruised. The rigidity and absorbency as well as the cushioning capabilities of molded pulp trays are believed to make them ideal protective containers for perishables.

They are also used for packaging products such as fluorescent light bulbs, wine bottles, toiletries, electronics, and pharmaceuticals. Specialty uses for molded pulp include stereo speaker horns, helmet linings, luggage shells, and flower pots made from pulp and peat moss.

The drop in demand for nursery products for landscaping, which was caused by the erosion in the construction industry in the early 1980s, reportedly drove a number of specialty molded pulp producers out of the business. One of the two major molded pulp producers, Keyes Fiber Co. (the other is Packaging Corp. of America), dropped manufacture of nursery items some years ago and, in fact, converted three of its molded pulp plants to production of plastic foam products for food service and commercial agricultural uses.

Diamond International Corp., formerly one of the top two producers, was acquired in 1982 by Sir James Goldsmith, who later began selling off its assets, and what is left is Diamond Fiber Products Inc., with a single plant in Palmer, Mass. Diamond sold the Red Bluff, Calif.; Natchez, Miss.; and Plattsburgh, N.Y., plants to PCA in 1983. The Natchez plant has been closed for some time, with no plans to reopen it.

The value of molded and pressed pulp products declined an estimated 1% in 1983 to $233.9 million, according to

NORTH AMERICAN PRESSED AND MOLDED PULP PRODUCERS

Company	Location	Capacity (tpd)
American Fibrit Inc.	Battle Creek, Mich.	30
Cascades Inc.	Kingsey Falls, Que.	32
	Rockingham, N.C.	25
CKF Inc.	Hantsport, N.S.	n.a.
Diamond Fiber Products Inc.	Palmer (Thorndike), Mass.	n.a.
Fibre Form Corp.	Columbia City, Ind.	n.a.
Fripp's Fibre Form Ltd.	Tisdale, Sask.	n.a.
Henry Molded Pulp Products Inc.	Lebanon, Pa.	15
Keiding Inc.	Milwaukee, Wis.	n.a.
Keyes Fibre Co.	Albertville, Ala.	n.a.
	Hammond, Ind.	n.a.
	Sacramento, Calif.	n.a.
	Waterville, Maine	n.a.
	Wenatchee, Wash.	n.a.
Middleton Packaging Inc.	City of Industry, Calif.	15
Montrose Paper Inc.	Chicago, Ill.	82
Packaging Corp. of America	Griffith, Ind.	88
	Macon, Ga.	88
	Plattsburgh, N.Y.	n.a.
	Red Bluff, Calif.	n.a.
Reid Dominion Packaging Ltd.	Brantford, Ont.	n.a.
Tekmold Inc.	Muskegon, Mich.	8
Woodstream Corp.	Lititz, Pa.	n.a.

n.a. = Not available.

BIE. The industry continued to shrink during the past decade, primarily due to competition from plastics, especially in the food-serving areas such as egg cartons and meat/produce trays, floral and other decorative items, and piping. From 1972 to 1985, the compound annual rate of decline was 3.7%, according to BIE.

However, the value of shipments rose slightly in 1984 to $235 million, then it rose to $260 million in 1985. It continued climbing to $271 million in 1986 and $282 million in 1987, according to Dept. of Commerce.

Imports are expected to continue to substantially exceed exports of molded and pressed pulp products in 1988 as they did in 1987, with exports projected at $6.3 million compared with $25.1 million worth of imports, according to Dept. of Commerce. In 1984, U.S. exports of pressed and molded pulp goods reached $3.8 million, a drop of 26.9%. Exports dropped another 2.6% in 1985 to $3.7 million but rose 16.2% in 1986 to $4.3 million. Principal exports markets in 1986 were Canada (60%), Costa Rica (10%), and Mexico (4%). Imports came from Canada (62%), Rep. of Korea (6%), Taiwan (5.5%), and Fed. Rep. Germany (5%). Mexico also is moving in on its northern neighbor.

Several years ago Keyes and PCA charged Canadian producers Cascades Inc. and Fripp's Fibre Form Ltd. with dumping egg filler flats in the U.S. since 1980. But the Dept. of Commerce ruled the dumping charge was unjustified, much to the Americans' surprise.

OUTLOOK

The value of shipments of pressed and molded pulp goods for 1988 was estimated to be 2.0% above 1987 levels, due to expansion primarily in the food-packaging sector. This expansion comes despite competition from plastic and polystyrene products, Dept. of Commerce predicts.

Pressed and molded pulp production will continue to grow between now and 1991, but expansion will be at a moderate rate of approximately 1.5%/year. Competition in food-packaging and egg-carton sectors will continue as molded pulp and plastic products struggle to maintain market share.

Growth in the molded pulp industry will depend on its ability to establish new end use markets for its producers, such as molded pulp trays for use in conventional and items microwave ovens. One of the major producers has a group working with the food industry to develop new products.

STATISTICS OF U.S. PRESSED AND MOLDED PULP INDUSTRY

	Number of establishments*	Employees (000)	Value of shipments ($ million)
1987e	—	3.1	282
1986	—	3.0	271
1985	—	2.9	260
1984	—	3.0	235
1983	—	3.2	227
1982	32	3.2	222
1981	38	3.2	239
1980	—	4.4	225
1979	—	4.6	220
1978	—	5.0	226
1977	38	4.9	240
1976	—	5.3	218
1975	—	5.3	210
1974	—	5.6	205
1973	—	5.6	168
1972	49	6.1	163
1967	58	6.7	146

e = Estimate.
* Data from Census of Manufactures.

Source: Bureau of the Census.

Microwaveable containers probably is one of the strongest growth areas because the molded pulp product will absorb excess moisture and help keep some products, such as the bottom of bread or rolls, from getting chewy as often happens now. Another recent development on the consumer level is the "dozen-and-a-half" egg pack.

American producers also are looking over their shoulders southward, as Titan S.A., Empaques de Carton, in Monterrey, Mexico, doubles its molded pulp capacity. Titan's main products are industrial packaging, kraft linerboard, and corrugating medium. Production is moving to Mexico as it did in the steel and electronics industries because of a cheaper labor force and favorable exchange rate. This has helped push the larger converters to attempt cost containment strategies through rationalization of operations and introduction of advanced or new technologies. But, for the time being at least, this industry remains profitable.

PLASTIC RESINS AND CONVERTED PRODUCTS

GENERAL OUTLOOK AND MARKETS

Plastic resins and films are used in a variety of paper converting operations, and they represent the principal competition to paper and paperboard packaging. Polyethylene (PE) is the largest-volume plastic resin used by the paper industry for coating and laminating applications, and PE film is widely used for wrapping and bundling tissue products. Other major resins used in packaging include polystyrene (PS), polypropylene (PP), and to a lesser degree, polyvinyl chloride (PVC).

The U.S. plastics industry recorded an 8.5% gain in production and a 9.7% gain in sales volume in 1987, with apparent consumption in the U.S. increasing to 55 billion lb. The average annual growth for plastics production during the past 25 years is 7.9%. Plastics have replaced other materials in hundreds of applications, including food containers, carpet fibers, furniture, and automobile parts. Some paper and paperboard products that face competition from plastics include kraft bags and sacks, milk cartons, folding cartons, paper cups and plates, composite cans, and corrugated containers.

Packaging consumed over 12 billion lb of plastic resins in 1987, or 23% of total industry output. Building and construction consumed 19%; consumer products, 9%; electronics, 6%; furniture, 5%; transportation, 4%; coatings/adhesives/inks, 4%; exports, 9%; and miscellaneous products, 21%.

Throughout 1987, packaging resins were in tight supply, and by year's end, plants were running at full capacity. Because of market tightness and the spiraling costs of chemical feedstocks, producers successfully raised

U.S. PRODUCTION OF SELECTED RESINS

(million lb)

Year	LDPE[1]	HDPE[1]	PS	PP	PVC	Total Industry
1987	9,599	7,995	4,780	6,647	7,971	55,751
1986	8,903	7,182	4,470	5,812	7,256	50,848
1985	8,889	6,671	4,054	5,139	6,772	47,946
1984	8,413	6,085	3,838	4,940	6,760	46,336
1983	8,041	5,691	3,767	4,434	6,066	42,777
1982	7,503	4,928	3,191	3,477	5,326	36,607
1981	7,693	4,695	3,621	3,955	5,707	39,867
1980	7,291	4,405	3,521	3,648	5,470	37,347
1979	7,793	5,010	4,005	3,841	6,119	41,577

[1] Includes LLDPE/HDPE swing capacity.

Source: Society of the Plastics Industry.

prices of the major commodity resins by about 30% in 1987. Further price increases have been announced for the first quarter of 1988. Bolstered by these rising prices and increased domestic demand, the industry is poised to expand capacity by 16% from 1988-90. This robust expansion follows nearly a decade of depressed prices, shakeouts, shutdowns, and overcapacity in the plastics industry.

During the first half of the 1970s, the plastics industry initiated a similar series of expansion and debottlenecking projects as resin inventories became increasingly tight. Eventually, the expansions led to significant overcapacity, resulting in a downward trend in profits and lower prices for resins. These market conditions prompted several major petrochemical companies to sell their commodity plastic resin businesses. However, the current activity suggests that resin producers are formulating their strategies with more prudence, especially with respect to the four major resins: PE, PP, PS, and PVC.

The major U.S. resin producers are also seeking to diversify their revenue base away from the cyclical commodity resin business and to integrate to downstream consumer products. Leading producers such as Amoco Chemical Co., Dow Chemical Co., Exxon Corp., Mobil Chemical Co., and Union Carbide Corp. have made investments in recent years to expand downstream fabrication of value-added products and to increase their total market share. For example, Dow Chemical, which produces PE resins and film, moved into consumer goods with the development of Ziploc resealable plastic bags, a product worth $200 million/year in sales. Dow increased the value of its PE film by a factor of four when it was converted downstream into bags.

The short-term outlook for the major-volume resins appears promising, despite concerns of a recession that might weaken demand. For 1988, resin output and prices are expected to continue rising, but availability will remain a problem. Industry analysts forecast a 4.4% increase in total U.S. plastic sales to 57.9 billion lb, while capacity increases to 60.5 billion lb.

Opposition to plastics packaging. Every major plastic resin is expected to show solid growth during the next several years. Among the factors driving plastics' penetration into packaging are new technologies that yield plastic materials that provide equal or better performance at lower cost per unit than other materials. But some developments are overshadowing these technological achievements: namely, the issue of solid-waste disposal.

Plastics packaging's permanence in the environment, because it does not biodegrade, and the low level of recycling of plastics products will be major concerns in the future. Although plastic accounts for only 8% of municipal solid waste, it is the primary target of restrictive packaging legislation because it is the fastest growing segment of the packaging industry. Disposable PS-foam food containers and plastic bags are receiving the most negative publicity, but several state and municipal governments are considering legislation to ban or tax any nondegradable or nonrecyclable plastic packaging.

PLASTIC RESINS

Packaging comprised the largest category of resin sales in 1987, about 12.8 billion lb, and accounted for some of the sharpest production increases.

Among the major packaging resins, high-density polyethylene (HDPE), commonly used for plastic bags and sacks and blow-molded containers, jumped 15.3% in 1987 sales, up from 5.2% growth in 1986. Low-density polyethylene (LDPE), used for plastic coatings, films, and bags, grew by 8.9%, compared with 2.5% growth in 1986. PS, used for disposable food-service products and foam packaging, rose 8.7%, compared with 6.7% growth in 1986. PP, which is used in injection-molded food containers and flexible packaging, increased about 13.3%, up from an 8.9% increase in 1986.

Polyethylene. Strong market conditions have prevailed in recent years for this major resin group, which accounts for one-third of total plastic industry capacity. Ten U.S. resin suppliers have announced PE capacity expansions totaling 3.4 billion lb for 1988-89. Current PE capacity is about 18.2 billion lb. Of that amount, 7 billion lb is HDPE, 7 billion lb is LDPE, and 4.2 billion lb is capacity that can swing between linear low-density polyethylene (LLDPE) and HDPE.

HDPE output is projected to rise 5% to 8.2 billion lb in 1988. Prices of blow-molding grades of HDPE rose 5 cents/lb in the fourth quarter of 1987 to 39 cents/lb. Producers announced a second 5 cents/lb hike in January. Demand for blow-molding resins has been strong for milk and juice containers, liquid detergent bottles, motor oil bottles, and shipping drums. Some grades of HDPE resins are also used to produce plastic bags and sacks.

LDPE and LLDPE output is also forecast to rise 5% to about 10 billion lb in 1988. LDPE producers raised prices by 3 cents/lb in the fourth quarter of 1987 to 38 cents/lb, and they announced a 5 cents/lb hike in January in response to rising ethylene feedstock prices. Although all PE resins are produced from ethylene feedstocks, LDPE margins are the

U.S. PRICE TRENDS FOR SELECTED RESINS

(cents/lb, 4th quarter)

Year	LDPE	HDPE	PS	PP	PVC
1987	38.0	39.0	53.0	44.0	37.0
1986	28.5	32.0	35.0	34.0	29.0
1985	30.0	31.0	34.0	36.0	27.0
1984	30.0	32.3	37.0	35.0	24.0
1983	40.0	37.0	—	—	—
1982	27.0	35.5	—	—	—
1981	28.0	39.0	—	—	—
1980	34.0	37.0	—	—	—
1979	38.5	39.3	—	—	—

Source: *Modern Plastics.*

most sensitive to ethylene prices, which increased sharply from 18 cents/lb in the fourth quarter of 1987 to 23 cents/lb in the first quarter of 1988.

The demand for LDPE has been strong for grocery sacks and retail bags, flexible food packaging, and shrink and stretch wrapping uses. Plastics' gain of about 30% of the grocery sack market and 75% of the retail bag market owes much to the lower prices of the plastic products. Heavyweight kraft paper grocery sacks sell for about $35 to $37/1,000 sacks, while plastic sacks sell for about $22 to $24/1,000 sacks. This price differential is expected to continue in 1988-89, leading to further market share loss by kraft paper.

LDPE is also widely used as a protective barrier coating on paper and paperboard substrates. In 1987, a total of 742 million lb of LDPE resins were used for coating applications, representing about two-thirds of the total plastics coatings consumption in the U.S.

Polystyrene. A 50% jump in PS prices in 1987 was caused mostly by soaring prices for benzene and styrene feedstocks. The upward price trend continued into the first quarter of 1988, as styrene feedstock prices reached a record-high level of 42 cents/lb and pushed PS prices to 58 cents/lb. Nonetheless, strong demand kept facilities operating at full capacity throughout the year, and supplies were tight for all customers. The forecast for PS growth in 1988 is about 3%.

PS producers are cautious of major capacity expansions, due to their narrow profit margins. Some expansions are planned for 1988-89, but they amount to less than 8% of the current industry capacity of 5.7 billion lb. One product that has boosted PS growth in food packaging is the fast-food clamshell container popularized by McDonald's Corp. Gains have been achieved in other fast-food disposables, resulting in the displacement of bleached paperboard cups, plates, and food containers. Egg cartons produced from PS resins have also dispaced molded pulp egg cartons.

Polypropylene. Producers raised prices by 10 cents/lb, or 30%, in 1987 based on tight market supplies and strong demand. Prices increased an additional 3 cents/lb to 47 cents/lb in the first quarter of 1988. PP resins are used to produce injection-molded food containers and bottle closures and flexible packaging films. Demand is expected to grow about 7% in 1988.

Nine U.S. producers plan to increase capacity by 2.2 billion lb from the current level of 6.9 billion lb between 1988-90.

ESTIMATED CAPACITY OF TOP 20 U.S. COMPANIES PRODUCING PLASTIC RESINS

	Annual capacity (million lb)	Major grades
1. Quantum[1]	4,225	LDPE, LLDPE, HDPE, PP
2. Dow	3,365	LDPE, LLDPE, HDPE, PS
3. Union Carbide	2,255	LDPE, LLDPE, HDPE, PVC
4. Huntsman	1,948	PP, PS
5. Chevron	1,935	LDPE, HDPE, PS
6. Exxon	1,860	LDPE, LLDPE, HDPE, PP
7. Phillips	1,800	HDPE, PP
8. Himont	1,600	PP
9. Occidental	1,600	PVC
10. B.F. Goodrich	1,545	PVC
11. Amoco	1,420	PP, PS
12. Mobil	1,415	LDPE, LLDPE, HDPE, PS
13. Eastman	1,400	LDPE, PP, PET
14. Soltex	1,400	LDPE, HDPE, PP
15. Fina	1,100	PP, PS
16. Allied-Signal	1,025	HDPE
17. Shintech	1,000	PVC
18. Cain[2]	900	LDPE, HDPE
19. Formosa	886	PVC
20. DuPont	760	LDPE

1. Formerly USI Chemicals Div. of National Distiller & Chemical Corp.
2. Company formed in 1987 from purchase of DuPont's HDPE business, plus plants from PPG Industries, Imperial Chemical Industries, and others. Sale of Cain to Occidental Petroleum Corp. announced in April 1988.

Source: *Modern Plastics.*

PLASTIC PACKAGING

Food packaging is the largest segment of the plastics packaging industry; therefore, plastic bottles and flexible films are the leading products in this segment of the industry. The plastic bottles and films are popular with food manufacturers because their barrier properties ensure freshness while preventing odors, moisture, or vapors from contaminating the product. Owens-Illinois, with its recent acquisition of Brockway Inc., is the largest U.S. producer of plastic bottles. Other major plastic bottle producers are Sewell Plastics, Johnson Controls, Continental Can, and Amoco. Leading film producers include Quantum, Dow, Union Carbide, Chevron, Phillips, Exxon, and Mobil.

Plastic bottles have made significant inroads into traditional glass and paperboard markets, and plastic films have successfully taken market share from cellophane, paper, and paperboard. Plastic bottle demand is projected to grow over 5%/year and use 7.6 billion lb of resins by 1992, according to a forecast by Freedonia Group Inc. U.S. demand for plastic film is projected to increase 3.3%/year and consume nearly 10 billion lb of resins by 1992.

Among nonfood applications, one of the most competitive markets has been grocery sacks, where kraft paper has traditionally been used. High-strength PE films have captured about 50% of the market, up from 5% six years ago. The leading plastic grocery bag producer is Sonoco Products Co., which also produces paperboard cores, cans, tubes, and plastic shipping drums. Sonoco produces about 6 billion plastic bags annually and has a 20% share of the 30-billion bag market. Its chief rival is Mobil Chemical, a subsidiary of Mobil Oil Corp., which produces about 4 billion bags annually. Sales of plastic grocery sacks are expected to increase at nearly 10%/year and hold 75% of the market by 1992, according to Kline & Co.

PLASTICS USE IN PACKAGING IN 1987

(million lb)

	LDPE	HDPE	PS	PP	PVC	Total Industry
Containers	256	3,331	1,055	438	310	6,433
Closures	33	89	234	263	36	676
Coatings	742	42	—	27	33	1,114
Film	3,085	414	57	537	232	4,426
Total	4,116	3,876	1,346	1,265	611	12,649

Source: *Modern Plastics.*

ELECTRONIC COMPETITION

Not long ago, some paper industry folks were wringing their hands and issuing dire warnings about electronic data interchange (EDI), which was supposed to create a paperless society. The call to battle was sounded by analysts, consultants, and others who had a stake in paper manufacturing, EDI, and businesses related to both.

Some still sound the alarm, and, in fact, electronic communication has affected the paper industry, but it has done so in both negative *and* positive ways. Nevertheless, the wholesale elimination of paper from daily use is not likely, and large reductions in paper usage and consumption are, if anything, probably a decade or more away.

This is due to the slow acceptance of services such as Teletext, videotext, electronic mail, and CD-ROM (compact disk/read-only memory); people still want to "see it" on paper. One area that has been making headway into paperless marketing is television home-shopping services. But the long-term popularity of these services already is in doubt at the same time as more retailers are introducing or expanding distribution of paper catalogs. Even major nationwide bookstore chains have gotten into the act by selling catalogs.

James L. Hutchison, vice president of the American Paper Institute's Paper Group, told the association's members in March 1986 that certain sectors of the paper industry were being hurt by electronic competition. For example, tabulating stock declined in 15 years from 550,000 tons to 100,000 tons in 1985. In 1974, demand flattened for one-time carbonizing paper and then began a decline in 1980.

Also in 1986, some marketing executives were predicting a threat to the paper industry. "Paperless marketing is here and it's a serious threat to your very existence," Harold L. Schwartz, president and CEO of The Stuart McGuire Co. Inc., told papermakers at *Pulp & Paper International*'s Publication Papers Conference in London. Stuart McGuire is a cataloger that also operates the largest cable shopping service.

"There are several very innovative and frightening situations arising now that are completely eliminating or at least drastically reducing the very need for paper," Schwartz said. "One of these is the introduction of home shopping via TV or through some other paperless mechanism."

But Schwartz's warnings are somewhat offset by the fairly weak acceptance of some electronic mechanisms. For example, videotext systems installed in corporate settings are indeed expected to grow nearly 70% annually for the next five years, but recent experiments in videotext for home use have been disappointing.

Sears, Roebuck & Co. tried an electronic catalog experiment in 1981 in which catalogs on videodisks (actually CD-ROM) along with paper catalogs were sent to 1,000 customers. The customers did not quickly accept the

ELECTRONICS-RELATED SPECIALTY PAPERS: U.S. MARKET SIZE AND STRUCTURE

(tons)

Grade	1987	1992	% change
Laser	75,000	152,300	103%
Direct thermal[1]	19,850	30,450	53
Dielectric	26,210	39,850	52
Vellum[2]	8,630	8,840	24
Ink jet	3,030	8,840	179
Thermal transfer[3]	1,300	4,730	264
Other	0	4,600	n.a.
Total	134,020	249,230	86

1. Includes domestic and imported.
2. Not including dielectric vellum.
3. All types.

Source: Diamond Research Corp.

concept, and Sears officials moved their estimate for general acceptance of this type of electronic catalog from the mid-1980s to the 1990s.

Although Sears did not find its customers quick to accept the new system, the economics of the idea seemed attractive to the company. About 90% of the $250 million/year that Sears spends on catalog production is for printing and distribution; the remaining 10% apparently is for photography and text writing. If an electronic system were implemented, the 90% portion could be reduced substantially, and the system would thereby attract more attention from catalog publishers.

A similar experiment with a different product, an encyclopedia, is being tried by Grolier Electronic Publishing. Andrew Reinhart, the former Grolier president and CEO who oversaw the CD project, said all 20 volumes of the *Academic American Encyclopedia* are on just one 4-in. disk that can be read by a personal computer with a CD-ROM disk drive. This type of reference work is less expensive than the printed version, but it does not have the photographs and illustrations found in books. Grolier, which probably is the third largest encyclopedia publisher behind Britannica and World Book, also is working on a CD-interactive system that will have sound, motion, and illustrations. Still, Reinhart does not expect his electronic encyclopedia to replace the printed page immediately. "It will not have any effect until the next couple of years" and will possibly take ten years or more to become widely used, Reinhart said. "It will not have a major effect on the total use of paper," he added.

Even larger programs were tried in France and the U.K. The British system, Viewtel 202, is an electronic newspaper in Birmingham, England, that has not been widely accepted. The French system, however, has become popular, at least as a personal communications network.

Warnings were also sounded for the demise of business forms. "The business forms industry may see a decline of 10% over the next several years, as complex (and profitable) forms for bills of lading, purchase orders, etc., are replaced by EDI," cautioned a 1987 study by International Resource Development Inc. (IRD). IRD went on to say that the biggest pinch will be with the overnight courier package, which typically contains paper and paperboard for packaging along with the mailing piece itself. Up to 30% of overnight package service traffic consists of documents that are vulnerable to replacement by EDI, said IRD. Ken Bosomworth, and IRD researcher, said that the effects of EDI will be felt after 1991, although many observers feel the late 1990s are more realistic.

Another consulting firm, the Gartner Group of New York, suggested that 70% to 75% of all Fortune 500 companies would have corporate videotext systems installed by year-end 1987 and that videotext would grow by 69% annually to become a $2- to $3-billion industry by 1996. Still others in the EDI industry think reaching $1 billion in 1990 is "optimistic."

The primary players in EDI are General Electric Information Services Co. and McDonnell Douglas Corp., database and bulletin board services such as CompuServe and The Source, and a number of newspaper publishing companies such as the Dow Jones News Retrieval service (some, such as the videotext service of the *San Francisco Chronicle*, have been discontinued, although a *Chronicle* subsidiary still operates an electronic sports information service). Electronic mail services are also provided by firms such as MCI and Western Union.

One area that has been affected by EDI is banking. The most important aspect here is the electronic transfer of funds (EFT), which can sometimes eliminate the need for paper transactions either between institutions or between customer and institution. With EFT, a consumer or an employee at a business can sit down at a computer and tell the bank's computer to transfer money from one account to another. This already is being done with some utilities. However, some EFT transactions are also confirmed on paper.

POTENTIAL OF TELETEXT ON MAJOR PRINTING PAPER GRADES

Paper grade	Potential impact—positive	Potential impact—negative
COATED PAPERS		
Coated groundwood and coated free-sheet	Magazines, brochures, promotional advertising, operating manuals, books	—
Thermal papers	Printer output	—
UNCOATED PAPERS		
Uncoated groundwood	Videotex directories	White telephone directories
Newsprint	—	Decline in classified use
Forms bond	Printer ouptut	—
Uncoated free-sheet (other)	Books, operating manuals	—
Check paper	—	Less check use

The ubiquitous automated teller machines (ATM) also were supposed to reduce paperwork, but they issue paper receipts for their transactions. Internal institutional paperwork is reduced, though. EFT is not expected to become a significant factor in reducing paper demand for at least another five to ten years.

OUTLOOK

Newsprint. Perhaps the most visible competition first occurred with newspapers. But while others were predicting the death of the paper-based edition, John G. Udell, former consulting economist for the American Newspaper Publishers Assn. (ANPA), disagreed, and his position seems to have triumphed.

In the ANPA economic analysis called "U.S. Newspaper Growth and Newsprint Consumption with Projections for 1995," Udell said, "There is little evidence that new electronic media will have an appreciable effect on newspapers and newsprint consumption at any time between now [December 1986] and 1995."

Udell, who is Irwin Maier Professor of Business at the University of Wisconsin-Madison, added that electronic communications systems will continue developing as competition to the daily newspaper and other established media. "For the foreseeable future, home electronic communications are most likely to be a supplement to the established media, and newspapers are likely to continue to prevail as the nation's largest medium of news and advertising information for many years to come," he said.

In fact, newsprint consumption increased substantially between 1977 and 1987, rising 32.5% for all users. By 1995, consumption should rise to more than 15 million tons from the 1987 total of almost 13.6 million tons.

Udell gave three major reasons for the failure of EDI to severely hamper newsprint growth:

- A large proportion of the U.S. population does not use computers. Although children receive computer courses in school and computers are increasingly used at work, a majority of people either do not know how to use a computer or do not care to use one in the home.
- Electronic communications technology (hardware and software), although declining in price, still is fairly costly. Many people are willing to spend hundreds or thousands of dollars for television and sound equipment, but such expenditures are primarily for recreational instruments.
- Utilization of the emerging electronic media requires considerable effort on the part of the user. Securing only 10% of the information contained in a typical daily newspaper would require much more effort than that required to read the newspaper. The new electronic communications media lack a major advantage of radio and television: the latter require even less expertise and effort than reading a newspaper.

Office specialty papers. Demand for office specialty papers is expected to double in the U.S. between 1987 and 1992, one study noted. Demand for these grades, which include computer printer and thermal papers, will rise from 134,000 tons in 1987 to 249,000 tons by 1992. Sales will jump from $931 million in 1987 to over $1.8 billion

MAJOR GRADES OF PAPER THAT MAY BE AFFECTED BY ELECTRONIC COMPETITION: U.S. PRODUCTION

(000 short tons)

	1987	1986	1983	1980	1975
Newsprint[1]	16,505	15,868	14,521	14,181	11,370
Groundwood specialties[1]					
Directory	605	600	450	450	300
Catalog	540	540	425	375	300
Groundwood forms	323	325	240	230	75
Groundwood book	65	70	125	130	130
Uncoated free-sheet					
Forms bond	2,140	2,100	1,700	1,500	950
Envelope stock[2]	900	850	700	660	460
Offset book	2,700	2,550	2,100	2,000	1,450
Bond and writing	2,600	2,375	1,840	1,800	1,000
Tablet	450	400	400	325	230
Coated paper					
Nos. 1 to 4, two-side	3,150	2,760	2,300	1,800	1,200
No. 5, two-side	3,300	3,120	2,960	2,400	1,650

1. North American production.
2. Does not include brown, bleached, or semibleached kraft envelopes.

Sources: *Pulp & Paper* estimates, Newsprint Information Committee, Canadian Pulp & Paper Assn., American Paper Institute.

by 1992, according to a recently released study.

The report, "Specialty Papers & Films: Imaging Media for U.S. Markets," said that by far the largest market is laser printer papers (75,000 tons in 1987), a relatively new class of office specialty paper. Demand should rise to over 152,000 tons by 1992, said the study's authors, Arthur S. Diamond and Lubo S. Michaylov, of Diamond Research Corp.

Major suppliers of these papers include Boise-Cascade Corp., the Hammermill unit of International Paper Co., James River Corp., and Mead Corp.'s Gilbert Paper Co. Perhaps the greatest opportunities for these mills are in electronic publishing, which Xerox Corp. currently estimates has only 4% penetration in the business community. A subsector is desktop publishing, used for business communication such as internal and external newsletters, annual reports and reviews, promotional brochures, presentation graphics, and camera-ready advertising copy.

Office equipment manufacturers predict that in about five years laser printers will match the quality of professional typesetting equipment, pushing laser printers ahead even more, the study said.

Direct thermal papers for telephone facsimile (fax) machines, among other uses, is the next largest market, with an estimated 19,850 tons of paper used in the U.S. in 1987—a 17% jump from 1986. Growth is expected to exceed 53% (30,500 tons) by 1992.

Diamond and Michaylov said they expect annual U.S. placements of direct thermal printers to reach 1.33 million units by 1995. Of that total, about 600,000 units will be fax machines. Other thermal paper will be used by calculators and point-of-sale devices, which produce bar code labels.

The major players in the thermal market, with estimated 1987 production and market share, are: Appleton Papers Inc., 7,250 tons, 36.4%; Labelon Corp., 2,500 tons, 12.6%; Nashua Corp., 1,750 tons, 8.8%; 3M Co., 400 tons, 2.0%; others, 500 tons, 2.5%; and imports (mostly Japanese) 7,500 tons, 37.7%.

Dielectric papers, used primarily for computer plotters, will gain market share in higher-quality "report-grade" sectors, but the cheaper utility-grade products will eventually fade from the market altogether, the Diamond report said. Smaller segments in this grade, translucent and vellum (cotton), will increase their small market shares. About 26,000 tons of these papers were consumed in 1987. Demand should grow by more than 50% to almost 40,000 tons in 1992, the study said.

Approximately 90% of the paper used in computer ink jet printers in 1986 was coated. But Diamond Research expects coated paper consumption to fall in favor of treated uncoated and plain bond papers. Consumption of coated ink jet papers in 1988 may fall to 70%. However, overall paper consumption by ink jet printer users will grow from just over 3,000 tons in 1987 to nearly 9,000 tons by 1992.

Hammermill and Mosinee Paper Corp. dominate this paper market, each with a 30% share. James River is the next single largest player with 10%, and others, including offshore mills, make up the final 30% share, the report said. These offshore mills are expected to lose market share to the U.S. manufacturers, accounting for just 10% of paper used for ink jets by 1992. In fact, several overseas printer manufacturers are negotiating directly with U.S. firms to supply paper to their customers.

Another shift will be away from rolls toward cut-size paper, the study said. The other grades covered by this report include nondielectric vellum papers (used for manual drafting, pen plotters, and diazo intermediate) and thermal transfer (used for some computer printers).

Use of various vellum papers is expected to grow about 25% between 1987 and 1992. Leading suppliers are Crane Co., Esleeck Manufacturing Co. Inc., Gilbert (Mead), James River, and Kimberly-Clark Corp.

The very small quantity of thermal transfer papers, which are similar to direct thermal grades, is predicted to grow 264% for the same five-year period. Key mills are Hammermill, James River, Georgia-Pacific Corp., and "a number of Japanese producers," the Diamond report said. Among additional companies interested in carving out a share are Eastman Kodak Co., ICI (Imperial Chemical Industries), and Ricoh Corp.

Some areas may still be affected adversely by electronics, but others will not. Here is what is expected in the various end use areas:

Business papers. More high-speed office electronic printers will be installed in the U.S., and the number of small, inexpensive, and less sophisticated computer printers also is expected to grow rapidly. In addition, businesses are increasingly using "intelligent" copiers to generate forms on plain paper instead of using preprinted forms.

Demand for bond and writing papers has grown tremendously in the last 20 years. Annual shipments rose from 372,000 tons in 1960 to 2.5 million in 1986. The U.S. market rose a healthy 9.0% in 1986 from 1985, following a 10% gain in 1984.

Forms bond. Richard Norton, a researcher with Dataquest Inc., said computer printers are expected to continue growing as a major market for cut-size bond and copy papers, although forms bond is likely to face some hurdles. He predicted that overall demand for cut-size papers used for computer printers and copy machines will grow 20.6% from 393,000 tons in 1986 to one million tons in 1991. Free-sheet paper will remain predominant.

Norton said that page (laser) printers used about 288,000 tons of cut-size paper in the U.S. in 1986, but demand will grow to about 786,000 tons by 1991—a 22.3% jump over the five years. Copier paper will post a much slower growth of just 4.0% over the five-year period, rising from slightly under 2.0 million tons in 1986 to almost 2.4 million tons in 1991.

For papers that are not cut-size, stock continuous forms bond will grow at 7%/year, from 1.7 million tons in 1986 to 2.4 million tons in 1991, Norton estimated. However, custom continuous forms will post zero growth over the five years, staying at about 1.2 million tons annually, he said. That is because computer printers now can produce forms from computer software programs, and intelligent copiers can produce forms directly on the copy paper.

Carbonless paper forms are also used for multi-part continuous forms. Carbonless paper, including basestock, represents a market of about 541,000 tpy and grew about 44.0% from 1981 through 1986.

Uncoated free-sheet bond represented 92% of all U.S. shipments to business forms converters in 1986, while uncoated groundwood, at 235,000 tons, made up the balance. The groundwood segment began to decline at the beginning of the 1980s, falling about 4.5% between 1982 and 1986 to 235,000 tons. At the same time, uncoated free-sheet for forms rose almost 47% to 2.2 million tons.

Copy paper. The increased use of plain paper reprography has cut down on the use of coated-paper copiers found mostly in institutions and other low-volume copy sites. Demand for paper for this type of machine is likely to grow dramatically in future years as a result of color copying capabilities, high-speed copiers, intelligent copiers, and other developments. Most copiers use cut-size paper.

Grades of paper other than cut-size bond can be used in nonimpact printers, including fan-fold or rolled forms bond, recycled paper, preprinted forms, coated paper, labels, and even plastics.

Directories. An area more likely to suffer in the short term, although this is still five to ten years away, is telephone directories. F. Robert Kaiser, manager of paper, printing and distribution for BellSouth National Publishing Co., told delegates at *Pulp & Paper's* Second Uncoated Groundwood Papers Conference in New York in 1985 that researchers believe the potential for videotext or electronic yellow pages is impressive. It is estimated that between 20 and 30 million households could use this service by 1990, and the increasing use of personal computers may help it along eventually.

Tele-Direct (Publications) Inc., the publishing arm of Bell Canada Enterprises Inc., started a test with personal computers in early 1987, but a company spokesman said the system will serve only business and government. It was to be fully online by the end of 1987. Also getting into the act is the French national telephone company, which is trying to push an inexpensive electronic directory system that is combined with videotext service. The company plans to replace all telephone books with electronic terminals by 1995, although so far this has not been widely accepted despite laws implemented to promote it.

Even more immediate is the perceived threat of phone-in yellow pages, which provide free updated advertising information to callers. Like videotext, it will require time for talking yellow pages to make serious inroads on printed directories. "In the short term, it will have no effect [on printed directories]," said Zachary Pavlides, president of a San Francisco-based consumer-oriented talking yellow pages service. "In the long term, it will affect them to the point of extinction," he boasted. In the service Pavlides offers, consumers call in to receive a telephone number, or they can be connected directly with a person or business.

Magazines. Magazines have been affected more than newspapers by EDI, although their demise is celebrated too soon by electronic competitors. The weekly news and other general-interest magazines have seen their ranks reduced, but special-interest magazines are expected to continue their strong growth. Many of these magazines use high-value paper, especially coated free-sheet, although lower-end specialty magazines have proliferated as well. "Unless there's a major downturn in the economy," Udell said, "higher-quality magazines will continue to enjoy growth."

Others say the industry's biggest problems in the 1980s are competing with the immediacy and growing magazine-type journalism of daily newspapers, the rise in magazine advertising rates that has caused some advertisers to cut down the number of pages they buy, and the specialization of readers' interests.

EDI and bar coding, which have the most immediate impact on business forms, are becoming more commonly used by paper companies and their customers for faster and more accurate inventory tracking and for general business communication.

"Today, a number of producers of newsprint, printing/writing papers, and containerboard are sending shipping manifests electronically to their customers on a regular basis," the American Paper Institute reported during the 1987 Paper Week conference. "During 1987, the electronic transmission of orders and invoices will be initiated by an increasing number of companies." API had warned a year earlier that EDI could cause a significant loss in the market for business forms by 1995.

EDI can help a company lower transaction processing costs for itself and its trading partners, API said. It can include all of the functional operations of a company, including but not limited to data processing, sales and customer services, accounting, purchasing, receiving and shipping, and production control.

One paper company that has made itself a leader in EDI is Westvaco Corp., which, through its WesTrak system, can send orders electronically to suppliers. It also keeps track of products during manufacture, shipping, and receiving. Westvaco plans to add invoicing and payment to the system.

API formed a joint committee of paper, printing, publishing, and corrugated box industries, which recommended that General Electric Information Services be used as a third-party network for EDI transmissions by those companies that do not connect directly with their trading partners.

PULPING/PAPERMAKING CHEMICALS

The pulp and paper industry continues its upward climb: production figures released by the American Paper Institute indicated sustained or steady growth during the first half of 1987 vs 1986 for pulp (3.7% vs 3.8%), paper (3.5% vs 2.8%), and paperboard (5.2% vs 4.9%). In Canada, the Canadian Pulp & Paper Assn. reported production increases for woodpulp of 7.5% over the first half of 1986 and paper and paperboard production increases of about 6.4%. Also, 1987 shaped up as one of the most profitable in history as price increases were introduced with great success for nearly all paper products. Not surprisingly, chemical suppliers enjoyed a strong year of increased sales, and many sectors were scrambling to expand in expectation of a continued strong market.

Among the star performers that helped boost chemical consumption were coated papers and paper-grade market pulp. API reported growth for coated paper at nearly 10%. Correspondingly, suppliers of kaolin, latex, and other polymers received a large boost in deliveries. Uncoated free-sheet production rose 3.4%, with a few alkaline papermaking conversions, and shipments of calcium carbonate, alum, and filling clays all fared well.

Market pulp production, softwoods in particular, gained in the U.S. (5.8%) and in Canada (9.1%), and operating rates (along with prices) seemed to be at a maximum. This contributed to increased consumption of sodium chlorate, chlorine, and caustic. Mechanical pulp output jumped 6.1% in Canada and 2.7% in the U.S., and hydrogen peroxide and other aids had a full year of growth.

In the specialty areas, suppliers also found high interest. For pulping, oxygen extraction has been fully accepted, and prebleaching retrofits are currently on the rise. (Strong interest in the Pacific Northwest is reported). Sodium sulfite solutions for mechanical pulps are very popular, and many manufacturers either have tried to use them or are using them currently. Sulfur got a kick from emulsified products, which are used in the makeup of cooking liquor. Anthraquinone and other pulping specialties were applied in spots only.

In papermaking, quality was sought universally by end users, and chemicals were satisfying many needs. Modified starches were being consumed at higher rates. The mills

CONSUMPTION OF PAPERMAKING AND COATING CHEMICALS

(000 tons)

Chemical	1987	1986	%change 1987-88
Dyes	14.0	11.5	8.5%
Polyvinyl alcohol	11.5	10.1	7.0
Polyvinyl acetate	87.5	85.0	2.0
Surfactants	26.5	22.0	4.5
Defoamers	66.0	59.0	3.0
Biocides	9.5	8.0	10.0

CONSUMPTION OF PULPING CHEMICALS

(000 tons)

Chemical	1987	1986	% change 1987-88
Lime	1,290.0	1,190.0	2.5%
Soda ash	207.0	200.0	2.5
Salt cake	515.0	510.0	0.5
Sulfur	139.0	110.0	4.0
Sulfuric acid	880.0	830.0	2.5
Sulfur dioxide	56.0	50.0	1.5
Sodium hydrosulfide	5.9	5.5	1.0

concerned with runability were applying more biocides and defoamers in customized shipments. The strength of the industry and the economy itself was reflected in the use of colored paper, produced through the addition of dyestuffs, which had a record year.

The pulp, paper, and paperboard industry is a multibillion-dollar market for the chemicals industry. By estimations from Frost & Sullivan Inc., coatings and fillers represent close to 1.0 trillion lb, bleaching agents are at 8.2 billion lb, pulping additives at 4.8 billion lb, sizing components at 4.3 billion lb, and forming aids at 357 million lb, while several others total close to 100 million lb. All told, the inputs of hundreds of inorganic and organic materials run to about 14 million tons. Roughly 65% of these materials require processing at the mill, although this is rapidly changing. The mills are seeking to streamline production, and the suppliers are gladly supplying products for the site-ready shipment.

The following survey shows the larger commodities by sources, with comments from suppliers and mills.

PULPING CHEMICALS: CHLORALKALI

Sources: Nationally, 75% of chlorine production is accomplished by diaphragm cells, 17% by mercury cells, 3% by membrane cells, and 5% by other technologies. There are 24 chloralkali producers at 50 locations with a total nameplate capacity of 35,144 tpd of chlorine and 36,425 tpd of dilute caustic. Chemical processing industries account for most of the chloralkali consumption (44% of chlorine, 34% of caustic), followed by pulp and paper (16% of chlorine, 24% of caustic), polyvinyl chloride, water treatment, and others.

Supplier forecast: Dow Chemical Co., the largest producer, has implemented a multimillion-dollar program aimed at increasing capacity while decreasing production costs and improving product purity. Its latest move concerns debottlenecking the plant at Freeport, Texas, where 550 tpd of chlorine should be available late in 1988. Dow also opened a small membrane cell demonstration

CHEMICAL CONSUMPTION BY U.S. PULP & PAPER ESTABLISHMENTS IN 1980 AND 1986*

(000 short tons)

	Quantity	
	1980	1986
Sulfur	95.0	110.0
Chlorine	1,335.1	1,750.0
Sodium hydroxide (caustic soda) (80% sol.)	2,154.0	2,350.0
Sodium carbonate (soda ash) (96% to 100%)	192.6	200.0
Sodium sulfate, incl. saltcake (100% Na_2SO_4)	495.0	510.0
Sodium chlorate (100% $NaClO_3$)	210.0	245.0
Aluminum sulfate (17% Al_2O_3)	481.0	600.0
Titanium dioxide	154.8	250.0
Rosin sizing	134.4	189.0
Lime	1,172.9	1,190.0
Kaolin & ball clay	2,271.9	3,900.0
Starch	1,110.0	1,550.0
Calcium carbonate (precipitated)	310.0	450.0
S/B latex	n.a.	139.0
PVOH	n.a.	10.1
PVAc	n.a.	85.0
Defoamer (commodity grade)	n.a.	59.0
Surfactants (commodity grade)	n.a.	22.0
Sodium hydrosulfite/borohydride	n.a.	20/14
Sodium hydrosulfide	>10.0	5.5
Sulfur dioxide	>50.0	56.0
Sulfuric acid	800.0	830.0
Oxygen*	10.0	100.0
Hydrogen peroxide* (100% basis)	17.0	40.0

* For pulp, paper and paperboard mills only (SIC Codes 2611, 2621, 2631).
n.a. = Not available.

Source: Bureau of the Census, *Pulp & Paper* estimates.

plant (30 metric tpd) late in 1987, in hopes of learning more about this emerging technology. The Japanese and others, both here and worldwide, have been successful with this technique.

OxyChem has acquired Du Pont Co.'s plant at Corpus Christi, Texas (1,260 tpd of chlorine, 1,420 tpd of caustic), and it reports high operating rates for its new membrane cells at Taft, La. Niachlor, a joint venture of Du Pont and Olin Corp., is nearing completion of the chloralkali unit at Niagara Falls, N.Y. (660 tpd of chlorine, 730 tpd of caustic). Startup was scheduled for December 1987.

Elsewhere, energy costs are reportedly rising in the Gulf Coast area; this factor may support the strong price rises since 1985. The latest price increases for caustic reflected regional market situations ($300/ton in the West, $200/ton in the East) as prices moved up $25/ton. Tight supply was forcing consumers, both with contract and without, to give proper notices (30 to 90 days) for modifications to orders.

CANADIAN MARKETS FOR MAJOR PULP AND PAPER CHEMICALS

(000 metric tons)

	Mill consumption* 1985	1986	Supply 1987
Pulping chemicals			
Sodium sulfate	194.0	200.0	Long
Limestone	265.0	280.0	Long
Lime	237.0	245.0	Long
Sulfur	166.0	167.0	Balanced
Sulfur dioxide	20.0	21.0	Balanced
Sodium hydroxide	250.0	260.0	Balanced
Bleaching chemicals			
Chlorine	506.0	520.0	Tight
Sodium hydroxide	649.0	700.0	Balanced
Sodium chlorate	186.0	195.0	Balanced
Sulfur dioxide	49.0	51.0	Balanced
Sulfuric acid	263.0	275.0	Balanced
Hydrogen peroxide	12.0	14.0	Long
Sodium hydrosulfite	8.0	9.0	Balanced
Sodium borohydride	16.0	17.0	Balanced
Oxygen**	35.0	42.0	Balanced
Papermaking chemicals			
Aluminum sulfate	91.0	100.0	Long
Rosin sizing	8.0	9.0	Balanced
Coating kaolin	86.0	100.0	Balanced
Other clays	90.0	100.0	Long
Titanium dioxide	9.0	10.0	Balanced
Calcium carbonate	5.5	6.5	Long
Starch	72.0	80.0	Balanced
SB latex	9.5	11.0	Balanced

* Consumption of purchased chemicals.
** Includes lime kiln and other mill uses for oxygen.

Source: *Pulp & Paper Canada.*

Most suppliers say prices will change on a quarterly basis into the foreseeable future. In regard to technology, the Univ. of Southern California reports that production of chlorine may become cheaper by using a process that separates hydrogen chloride through burning with a catalyst and separating through chemical and physical means, instead of using the electrolysis of brine to produce coproducts.

Mill demand forecast: Although new technologies have threatened to replace chloralkali products in pulp mills, pulp producers still feel they are the most cost effective. Recently, the Environmental Protection Agency reaffirmed federal guidelines on limitation of BOD_5 and color discharges by keeping mid-1970s legislation intact. This is sure to hold oxygen delignification installations at a low level, guaranteeing chlorine and caustic a home in chemical pulp bleacheries in the near future. In Canada, the situation is quite different, and a turnover of systems appears imminent. Caustic may receive another boost as mills experience good results with modified cooking techniques.

SODIUM CHLORATE

Sources: Total North American capacity is approximately 844,000 tpy, with six commercial sites in the U.S. and 13 commercial sites in Canada. Output in Canada was up over 18% for the first half of 1987 (influenced by strong exports to the U.S.), while U.S. plants were running at 95% operating rates. Both solution and crystal products are manufactured, the latter gaining in popularity because of the economics involved in shipment, particularly from Canada.

Supplier forecast: In 1987, the prices for solution were $355/ton (freight equalized MacIntosh, Ala.), and crystal prices were $350/ton (average delivered cost). These reflected a rather balanced supply/demand situation, as suppliers continued to jockey for position in the current market as well as the future one. Spot customers were paying substantially higher prices, especially on the West Coast. Canada had the most capacity changes over the two years to 1987. The Alby-Olin joint venture started up in September 1986 (55,000 tpy). Canadian Oxy added 7,000 tpy at its Brandon, Man., mill early in 1987. QueNord Inc. opened its expanded facility in Magog, Que., in September 1987 in an effort to triple capacity over two years to 101,000 tpy. ERCO Manufacturing Co. plans expansion and modernization projects that will lift capacity in North Vancouver, B.C., to 84,000 tpy and in Buckingham, Que., to 70,000 tpy.

Mill demand forecast: There is currently a great deal of interest in expanding chlorine dioxide generating capacity. *Pulp & Paper Project Report* lists five sites that announced new equipment in the U.S. for 1987, with many projects planned for 1988 as well. Canada has also moved forward with several projects. For existing bleacheries, there is renewed interest in employing higher substitution rates in the chlorination stage for more efficient bleaching of pulp. In new or overhauled bleach plants (i.e., sequence splitting, etc.), the technology of high-substitution ClO_2 seems to be part of the project.

HYDROGEN PEROXIDE

Sources: Du Pont, FMC Corp., and Interox America have been joined in the North American market by Degussa Corp. and Atochem from western Europe. Capacity is up to 275,000 metric tpy (100% basis).

Supplier forecast: Growth in capacity has not influenced prices as much as first thought in this boom market for hydrogen peroxide. Prices have remained steady at $0.325/lb (50% basis) for nearly three years, and demand (both real and potential) is keeping that level firm. Two plants began operation in 1987. Du Pont's Maitland, Ont., facility reached full production early in the year at 80 million lb/year, making it North America's largest producer. Degussa's Mobile, Ala., plant began operation in fall 1987 and is also slated for 80 million lb/year. Another plant in Canada, constructed by OxyChem Canada (jointly owned by French companies L'Air Liquide and Atochem) and expected to produce 44 million lb/year, was scheduled to be online in 1987. FMC, after pulling out of a project at Squamish, B.C., decided to invest in a plant in Thailand. Many suppliers paint a rosy picture for the future, in which hydrogen peroxide will be the chosen oxidizer of Third World countries for water treatment and agricultural uses. Countries in the Far East have already adopted the chemical as such. In technology news, Degussa says hydrogen peroxide can be used in wet scrubbers for small-scale removal of SO_2 in stack gases.

Mill demand forecast: Most hydrogen peroxide is used in bleaching mechanical pulps, although it does have a share in both chemical pulp bleaching and deinking. Mechanical pulp producers, especially the manufacturers of market chemi-thermomechanical pulp grades (which are commanding a good share of tissue and toweling markets and presently have a foothold in printing and writing grades), are turning to hydrogen peroxide as the chief component for whitening pulp. Systems use between 1% to 2% on oven-dry (o.d.) wood in either one- or two-stage processes, combining with sodium hydrosulfite in some cases. Three large mechanical pulp plants are under construction in Canada, and two are being considered in the U.S. There have also been a number of new newsprint and groundwood paper capacity announcements. In Europe, interest in mechanical pulp has spurred the announcement of at least two new hydrogen peroxide projects for 1988. In chemical pulp bleaching, there has been moderate growth in hydrogen peroxide as a final polishing step for market pulp (especially for export) and for use in extraction stages. Newly released evidence claims large efficiency gains in Eo stages with addition of H_2O_2. In German sulfite mills, this technology has helped to eliminate first-stage chlorination, thus reducing effluent loads. One mill in the U.S. has adopted this technique.

OTHER SODIUM CHEMICALS

Sources: Two producers, Olin and Virginia Chemicals Inc., operate five plants producing sodium hydrosulfite products in the U.S. Morton Thiokol Inc.'s Ventron Div. operates a sodium borohydride facility in Danvers, Mass., and will be joined by Covan Ltd., which plans to manufacture a similar product in Conshohocken, Pa. Sodium hydrosulfite capacity stands at 76,000 tpy, while sodium borohydride capacity with the new unit (three million lb/year) should be around 20,000 tpy.

Supplier forecast: Because of the success of mechanical pulp production and the demand for more brightness in groundwood grades, both chemicals have

PRICE TRENDS FOR MAJOR CHEMICALS USED IN THE U.S. PULP AND PAPER INDUSTRY

(f.o.b. producing plant)

	Unit	1986-87	1985	1984	1983	1982
Calcium carbonate (precip.)	$/ton	$210-215	$95-140	$140-195	$170-180	$160-170
Caustic soda (50% sol.)	$/ton	90-150	175-195	255	265-150	315-285
Chlorine	$/ton	180-200	195-200	195	145-180	145
Hydrogen peroxide (70% sol.)	¢/lb	45	45	45	43	39.5
Kaolin clay (prem. No. 1 coating)	$/ton	100-140	94-110	94-120	155	142
Lime	$/ton	45	39-45	35	—	57.8
Polyvinyl alcohol	¢/lb	105	100-105	100	105	105
Saltcake (sodium sulfate)	$/ton	65-98	90-115	90-113	91	79-86
Sodium chlorate	$/ton	330-400	420-440	540	420	420
Sodium hydrosulfite	¢/lb	60-66	64	71	60-63	60
Corn starch (unmodified)	$/100 lb	12-15.5	11-14.5	12-14	11.50-15.88	11.50-12.25
Styrene-butadiene latex	¢/lb	80	77-81	77	71-75	75
Sulfur	$/long ton	85-120	102-160	109-150	131-124	138.75-132.50
Titanium dioxide (anatase)	¢/lb	79	70-73	69.5	70	70

Source: *Pulp & Paper.*

enjoyed about 4% increases in shipments in North America. Due to the increased use of hydrogen peroxide and to factors pertaining to cleaner wood for pulping (e.g., woodroom improvements, screening efficiency), the consumption per ton of pulp will probably decline. However, in an attempt to reach new brightness standards for some newsprint products and groundwood specialties, more attention is being focused on existing bleacheries that, for the most part, employ dithionite. Virginia Chemicals released a new product called SUS-PEN that can be delivered in a 33% suspension. Previously, product was shipped in 11% or 13% solutions. Prices for customized products increased in mid-1987.

Mill demand forecast: In the newer projects, the choice for a mechanical pulp bleacher is primarily hydrogen peroxide, with support from dithionite. Some existing systems use H_2O_2 to polish dithionite bleached pulp. Price competition between the two might result in dithionite's being the winner (e.g., if energy costs shoot up), and the tide might be reversed. Nonchlorine bleaching of chemical pulps may have great potential, should that technology ever be commercially explored.

OTHER PULPING CHEMICALS

Sodium sulfite is very quickly gaining acceptance in pulp production. Both semichemical and thermomechanical mills are using it, the former as a substitute for soda ash and sulfur and the latter for chemical treatment that increases pulp strength in papermaking. Consumption amounts vary (0.5% to 4% on o.d. wood), but mills are most happy with its site-ready applicability. The main supplier, Koppers Co. Inc., recently expanded two plants (Petrolia, Pa., and Tuscaloosa, Ala.) to facilitate delivery of all grades.

Interest in **oxygen** is still very strong. Startups of oxygen delignification units, which consume ten times as much chemical as oxygen extraction systems, are the chief contributors to growth in oxygen consumption. Some mills also use it to enrich treated water at discharge pipes and to boost capacity of lime kilns. In supplier news, Airco Industrial Gases is spending $135 million to build or expand separation units in Nashville, Tenn.; Claymont, Del.; Vancouver, Wash.; and Trail, B.C. (concerning oxygen). Air Products & Chemicals Inc. has been awarded a patent for a new membrane separation technique.

Sulfur, sulfur dioxide, and **soda ash** used in sulfite pulping remain in a no-growth situation. Small production gains in Canadian sulfite pulping and use of emulsified sulfur for sulfate liquor makeup have helped offset any decline due to sulfite plant closures. The market for sulfur and soda ash is improving as far as price is concerned, with supply thinning and some recovery occurring in the bread-and-butter markets (e.g., construction, glass, chemical processing).

Sodium sulfate and **sodium hydrosulfide** are also stagnating. Tighter control of the recovery loops (such as more efficient boilers and the use of spent acid from chlorine dioxide generators) and the use of products that require less mill processing (such as emulsified sulfur) are reducing consumption of these once-popular liquor makeup chemicals. **Lime** usage is in a similar situation, with no growth foreseen except in following industry production. But one bright spot for lime is the installation of onsite calcium carbonate (see following section on papermaking chemicals).

Sodium silicate is slowly being replaced by customized formulations, whose chief component is **surfactants. Defoamers** in washing pulp are doing well, as many brownstock washing systems operate at overcapacity. **Sulfuric acid** was bumped in price during second-quarter 1987 due to strong export markets.

PAPERMAKING CHEMICALS: ALUMINUM SULFATE

Sources: Several companies sell a variety of grades. Production of aluminum sulfate products stood at 3.2 million tons in 1986.

Supplier forecast: The prices and consumption of all grades have been flat for several years, mostly due to downturns in usage for municipal water treatment. One expansion has been announced. General Alum & Chemical Corp. will build a $1.5-million plant (its third) and R&D center in Saukville, Wis. Completion of the 40,000-tpy (dry) plant was scheduled for late 1987, while the R&D center will be finished in 1989.

Mill demand forecast: Traditionally, increases in consumption of alum are tied to industry production, since nearly all systems use it for pH control while adding paper size. With several fine papermakers converting machines to an alkaline system or bringing on new machines incorporating this technology, the amount of alum consumed is being reduced an average of 30%). Mills are also using polymers or lime for wastewater treatment, another area where alum is popular.

CALCIUM CARBONATE

Sources: Production of calcium carbonate reached over 1.5 million tons in 1986, most of it being natural ground grades. Two firms supply precipitated grades for papermaking applications.

Supplier forecast: Following some mergers and acquisitions, the dust has settled, resulting in a competitive market. The greatest development was the announcement of five new onsite generators. Pfizer Minerals, Pigments & Metals Div. claims four of these. It purchased a 42,000-ft^2 laboratory and office complex in Bethlehem, Pa., from Gulf & Western Industries. The space will be used to house a technical staff that has tripled over three years. The other generator supplier is Steel Bros., a subsidiary of the Canadian conglomerate. Because of an oversupply situation, an upward price movement has not been predicted for the near future. Discounting exists in a few regions.

Mill demand forecast: Since one or two machines switch to or begin alkaline papermaking every year, the use of calcium carbonate will grow as long as it remains cheaper than fiber. Many mills are trying to use ground grades (fine and ultrafine) for cost savings, and one observer noted that several companies are researching onsite generation. Some observers have suggested that coating applications are slowing as filler applications grow stronger. Mills comment that conversion to alkaline is not the problem, but running at full production with an alkaline system is the real challenge. Reduced wire and fabric life, foaming, and overloads in the whitewater system seem to be the biggest hurdles.

CORNSTARCH

Source: Twenty-one corn processing plants are located in the U.S. and four in Canada. Major new capacity has come onstream since 1985, mostly for milling corn and drying products.

Supplier forecast: Prices for unmodified products (pearl starch) have never held to list, and discounting of up to 50% is not uncommon. Overcapacity does not help the situation nor does new product competition from potato starches and other surface sizing (polymers) and retention aids. Although enjoying success with products such as high fructose corn syrup, the market for specialty starches (modified products) has been riding the wave of end user demands for high-quality products. On the technology side, two equipment developments are helping to maintain starch use.

One is Jylhävaisio Oy's new "in a pipe" starch cooker, which is very popular in Europe for wheat and potato starches. Another piece of equipment pushed by suppliers is the new high-speed surface sizer. This device, now manufactured by four companies, incorporates the short dwelltime concept made popular by the generation of blade coaters installed during the 1980s.

In technology, Degussa claims a major breakthrough in the modification of starch. It has developed a process in which an inorganic catalyst is mixed with a reagent (an epoxide compound) and added to dry starch. The reagent chemical bonds to the starch, giving a cationic charge. The advantages of this process are said to be a higher yield of cationized starch, lower investment in conversion equipment, and no effluent. Starch is also being investigated for use in the production of a biodegradable film for the fast-food industry.

Mill demand forecast: Mills have been most interested in the ethylated and oxidized grades as well as the cationic and amphoteric grades for wet end addition. These are easy to use and contribute to overall paper quality improvements across all grades. Wet end addition is usually below 5-lb/ton rates for printing and writing grades. However, larger amounts are common in the production of board.

Potato starch: Historically consumed in Europe, this product is now being applied in paper machine wet ends as retention and drainage aids and as a strength enhancer in finished paper. A.E. Staley Manufacturing Co. and Nalco Chemical Co. market potato starch products in North America.

KAOLIN

Source: Most of the clay mined and processed in the U.S. comes from Georgia. Seven companies operate in 14 locations, where nearly 11 million tons were produced in 1986.

Supplier forecast: Product lines of kaolin grades have spread fantastically since 1984. Calcined clays have also gained with the squeeze on titanium dioxide supply. As has occurred in the industry itself, kaolin grades have experienced a split in their consumption. The value-added grades (upper end) have been accepted for the more expensive paper grades, while lower-class grades of paper have used lower grades of kaolin in combination with other products. Prices have moved up nicely, as demand has been strong. Two manufacturers have expanded or modernized their facilities for value-added products and additional capacity. Engelhard Corp. announced plans to spend $40 million on its Gordon and McIntyre plants, projects set for completion in 1988.

Mill demand forecast: As more kaolin products become available, industry use will increase. Modernizations at manufacturing sites improve product uniformity and quality. Both dry and slurried products are being used, depending on distance from the chosen supplier. As fiber becomes more expensive and scarce and as coatings are relied upon for superior printing surfaces, consumption of kaolin will certainly rise. In Europe, Georgia kaolin products are being made more available through the installation of shoreline slurry plants. ECC International Ltd. and Thiele Kaolin Co. are operating such facilities on the Baltic Sea and the English Channel.

TITANIUM DIOXIDE

Source: Production of titanium dioxide reached almost one million tons in 1986. Imports are on the rise as domestic production, hurt by environmental constraints, cannot fulfill domestic demand. TiO_2 is produced by four companies at eight locations. Canada has two suppliers.

Supplier forecast: Prices were climbing upward even before the industry turnaround, due to rising interest in titanium products (e.g., defense products) and to capacity reduction in the U.S. The processing of TiO_2 is changing in the U.S., but conversion is slow and hampered by a strong market for products. Consequently, many foreign and domestic companies have chosen to build plants offshore. In the U.S., SCM Corp. has decided to expand its Ashtabula, Ohio, No. 2 plant by 18,000 tpy at a cost of $18 million. Du Pont has chosen the offshore route and plans new ventures in Taiwan, Rep. Korea, and Brazil. SCM is expanding plants in England and Australia. Kerr-McGee Chemical Corp. is hinting at expanding its Hamilton, Miss., plant by 21,000 tpy, but it remains a partner in projects in Saudi Arabia and Rep. Korea. Tioxide Group plc, based in the U.K., is expanding its Sorel, Que., plant by 10,000 metric tpy and its French plant by 25,000 metric tpy. NL Chemicals Inc. is starting up a plant in Varennes, Que. (40,000 metric tpy), thereby raising its

Canadian output to 76,000 metric tpy. A Japanese player, Ishihara, is building a 36,000 metric tpy plant in Singapore.

Mill demand forecast: Papermakers are seeking alternatives to TiO_2 for cost and supply reasons. It is the most effective opacifying chemical, but extenders and enhancers are saving on the industry's use of them. Plastic pigment, latex, and calcined clay are helping TiO_2 in manufacturing. As end users and new paper products push for higher quality, TiO_2 will still be a major chemical input, but chances are it will be imported and more costly.

OTHER PAPERMAKING CHEMICALS

Dyestuffs have grown tremendously over the past two years. The conversion of handling systems to facilitate liquid products has led to consumption increases across all grades. Dyestuffs help mills manufacture the "just-in-time" order, and they decrease production costs through less waste, cleanup, and handling.

Latex also had a great year in 1987. This product contributes to the improved printing quality of coated grades, with less preparation time and less cost. Price pressure forced some suppliers to reevaluate list price ($0.80/lb), as discounting was up around 25%. New products are also hammering away at latex, with success in some paper grades and particularly in board. In an offshore development, Dow is building a 30,000-tpy plant in Hanima, Finland, in support of all the innovative coated paper expansion there.

Rosin size is in a position similar to that of its additive brother, alum. Some upward price movement was recorded during third-quarter 1987 when Akzo-Chemie Inc. raised its prices across the board by almost $0.05/wet lb. Tenneco Inc. started up a rosin plant in Charleston, S.C., with a capacity of 30,000 tpy.

CHEMICAL BYPRODUCTS

Silvichemical products can be classified under the following categories: (1) tall oil products, (2) rosin products, (3) turpentine, (4) lignosulfates, and (5) wood and bark chemical products. Tall oil and turpentine are the major byproducts of the sulfate (kraft) pulping process. Rosin is distilled from pine tree tappings (gum rosin), from pine stumps (wood rosin), and from tall oil (tall oil rosin). Lignosulfates, the metallic salts derived from the lignin in wood, were formerly produced from only spent sulfite liquor (SSL) but are now being made from sulfate black liquor as well. Wood and bark products range from charcoal to ethanol to wax.

CRUDE TALL OIL

U.S. fractionating capacity: 856,000 tpy.

Sources: International Paper Co., owner of Arizona Chemical Co. and Sylvachem Corp., has the largest U.S. capacity to fractionate crude tall oil (CTO) with two plants in Florida and one in Louisiana. Other paper producers (Georgia-Pacific Corp., Westvaco Corp., and Union Camp Corp.) have fractionators at or near their pulp mills. Hercules Inc. and Reichhold Chemicals Inc. maintain another six plants, five in the Southeast. No new capacity has been announced.

Supplier (mill) forecast: The supply of CTO has been on a rollercoaster throughout the 1980s. In times of high utilization rates of pulp mills, CTO is most likely to be in oversupply and the price crashes downward. Quite the opposite is true in times of industry slowdowns. Since 1980, the price of CTO has hit a high of $285/ton and sunk as low as $80/ton.

Factors curbing CTO production over the long-term are many. The use of hardwood for numerous paper grades that traditionally used softwood is climbing. The last ten years have seen an overall decrease in the harvesting of softwoods

PRODUCTION AND DISTRIBUTION OF CRUDE TALL OIL FRACTIONS

Year	Crude tall oil[1]	Tall oil fatty acid[2] Total production	Tall oil fatty acid[2] Production of less than 2% rosin content	Tall oil rosin[2]	Distilled tall oil[2]
1985	866	412	225	430	98
1984	881	472	239	453	105
1983	864	424	230	395	101
1982	785	368	195	318	93
1981	885	444	219	407	103

1. 000 short tons.
2. million lb.

Source: *Pulp & Paper.*

(3% per the American Pulpwood Assn.), although drastic changes in weather patterns (e.g., drought in 1985 and heavy rains in 1986 in the Southeast) have made trend analysis difficult.

Recycled fiber is also being integrated as a larger furnish component in grades such as linerboard and corrugating medium. The U.S. recovery rate of paper has been on an incline for over 20 years. The number of installations having pulp processes that do not yield CTO, chemi-thermomechanical pulp, and pressurized groundwood, for example, is growing in North America as producers drive for higher yields of fiber. CTO is also a potential fuel source for mills though not in the current period of low energy costs.

Chemical pulp expansion in North America is expected to be less than 1%/year through 1990. Therefore, the CTO supply will have to be maintained in other ways. New harvesting techniques, helping to keep the roundwood storage time down, along with innovative recovery ideas may offset some of these long-term losses. Other suggestions for higher yields include improved process control in digesters, improved skimming efficiency through new systems such as air injection, chemical addition to increase soap flocculation, and electroflocculation.

Fractionator forecast: Unfortunately, the demand for CTO products, tall oil fatty acids (TOFA), tall oil rosin (TOR), and distilled tall oil (DTO) is never synchronous with the supply of CTO. In 1987, the demand for TOR products was at high levels, supplying the paper industry with rosin size and the printing and adhesive industries with tackifiers. The demand for TOFA products was flat, as an oversupply situation existed and end user markets were in a highly competitive state.

High prices in the mid-1980s caused a shift in consumers' use of raw material, and cheaper soya and tallow oils gained entry into the end user markets. The reaction of the TOFA producers was to maintain high inventories and to wait for the high CTO supply levels to subside. CTO products can be stored indefinitely.

SULFITE PULPING BYPRODUCTS

Sources: Only a half dozen mills continue to produce lignosulfonates from SSL, and even fewer may do so by 1990. The new players in this market are People's Rep. China and the U.S.S.R., both of which export product throughout the world and will increase their share in the North American market. Torula yeast is produced by only two Western sources (one in the U.S., the other in Switzerland) and by four in Eastern Bloc countries.

Supplier (mill) forecast: Low-yield sulfite pulping capacity is declining worldwide, primarily due to environmental concerns. The supply of SSL is also being curtailed by cross-recovery methods by mills that maintain sulfite pulping facilities.

Producer forecast: Many growth areas exist for SSL products. They serve as chemical intermediates, binders, and dispersants in many industries. Some of the most successful and growing end uses are in chemical production, such as dyes; building products in construction, particularly in road maintenance; water treatment; and agriculture. Traditional areas of use that have been declining lately include mining and oil exploration.

In vanillin production, there is a hazy outlook for the future supply. ITT Rayonier Inc. seems to be the only player in it for the long run, as the company continues to expand its product line as well as its facility. After the conversion of Quebec & Ontario Paper Co. Ltd.'s pulp complex at Thorold, Ont., the 9-tpd vanillin plant was closed. Monsanto Co. sold its 6-tpd plant in Seattle, Wash., to Rhône-Poulenc. Rumors persist that this plant may not be operating in the next decade.

SULFITE BYPRODUCTS AND THEIR MARKETS

SSL derivative	Industrial application	Forecast (1986-90)
LIGNOSULFONATES		
Dispersant	Construction	Steady
	Chemical production	Growing
	Oil drilling	Flat/declining
Binder	Agricultural	Flat/growing
	Chemical	Flat
	Mining	Growing
Chemical intermediate	Mining	Flat
	Construction	Flat
	Cleaning/water treatment	Growing
VANILLIN		
Commodity vanillin	Food	Growing
	Drug	Growing
Ethyl vanillin	Chemical	Steady
Vanillin black liquor	Kraft pulping	Flat

Source: *Pulp & Paper.*

WORLD REVIEW

The world made 215,611,000 tons of paper and paperboard in 1987, 6% more than in 1986. It was the fifth record year in a row for output. Pulp production totaled 156 million tons, up nearly 5%, also continuing a five-year climb. And 1988 is likely to keep the trend going upward. Is no end in sight?

Production has kept in step with the rise in apparent paper and board consumption. It too has increased every year since the bad year of 1982. In 1987, it was 214 million tons, up nearly 6%. However, the world's population rose again, such that the world's per capita consumption stayed at 42 kg (92 lb).

The amount traded remained about the same compared with 1986: slightly more than one ton of paper in every five crosses a frontier. For pulp, it's less—about 16% of output is traded. The world's export and import figures almost balanced, a gap of 1.2 million tons for paper and board and of just 35,000 tons for pulp.

It was a good year for many papermaking nations, and of course records were set for most of the big producers. The unfortunate exceptions were several countries in southeast Asia and Africa.

North America had a bumper year. In many pulp, paper, and board sectors, mills had difficulty meeting demand and, naturally enough, U.S. domestic buyers took precedence over export trade. The U.S. continues to dominate the league table of paper producers, making 31% of the world's entire output. The Canadians, taking advantage of the decline in the U.S. dollar's value against other major currencies, boosted their exports 6%.

Many European countries also made more than ever before during a year in which the jump in demand, particularly for printings/writing grades, came as a surprise to many. Ten of the 19 western European nations enjoyed record paper and board production levels. The three export-oriented Nordic nations produced a million tons more paper and board than in 1986, crossing the 17-million-ton mark. Pulp output increased by approximately the same amount and topped 20 million tons for the first time. East European countries had more modest increases, with the exception of the Soviet Union, where preliminary output figures show an increase of 6%.

Earthquakes aside, New Zealand and Australia are both showing much more activity. Though paper and board output was close to the previous year, companies in these two countries are busy merging and acquiring and investing in new capacity.

Japan's paper and board output continued its inexorable climb even while the industry carried out some extensive restructuring. One major difference in 1987 was that this was the largest annual increase in paper and board output (+7.2%) in its current record run since 1983.

China continued its steeply rising increase in paper and board output, up 14% to 11.4 million tons, and more is expected as some modernization programs and plans to improve the fiber supply come to fruition.

Other rapidly growing Asian producers did not meet their goals, but Rep. Korea still managed to raise production by 14%, crossing 3 million tons, and Taiwan had to be satisfied with an 8% rise. These four plus Turkey, which is perking up, account for 90% of Asia's output, but newcomers are beginning to grow now, Indonesia and Thailand in particular. India carries on, steadily raising output, and it has scored some noticeable successes in producing newsprint. However, old problems remain, such as expensive energy and a lack of available raw materials.

Several of the key Latin American nations did better than expected in still-difficult economic conditions. The future for the pulp and paper industries of Brazil, Chile, Argentina (which joined the million-tonners' class for the first time), and Venezuela is looking brighter than it has for several years. International investors are now being attracted by the fast-growing forests and low-cost bases that these countries have to offer. By 1992, several large pulp projects will be coming onstream in Brazil and Chile.

Africa remains a sorry tale, with output almost stagnant, and measurement was made much more difficult following South Africa's decision not to publicize its production figures. It seems that the present process of economic restructuring in several key countries will have to be completed before output picks up.

NORTH AMERICA

Last year was a highly profitable one for pulp and paper producers in North America. Domestic demand was strong, increasing at rates that were higher than GNP, and exports were assisted by the low value of the U.S. dollar against other currencies. Pulp and paper mills operated at near full capacity, and many of them recorded record profits for the year.

Total North American output of paper and board reached a record-high 83.6 million tons in 1987, up 5% from 1986. Among individual grades, newsprint output was up 4% at 14.97 million tons, printing/writing papers were up 6.5% at 21.25 million tons, and packaging grades were up 5.1% at 28.43 million tons (kraft linerboard production rose 7.1% to 16.88 million tons). Total imports rose by 6.1% to 11.7 million tons, while total exports reached 15.2 million tons, up 7.3% from 1986.

Pulp output climbed to 77.1 million tons, also up by about 5%. Output of market pulp was 15.4 million tons, a rise of 8% from 1986. Pulp exports were 11.9 million tons, an increase of 6.6%.

Domestic demand for paper and board was strong. The American Paper Institute estimated that real per capita consumption in the U.S. climbed above 300 kg (660 lb) for the first time to 302.5 kg (665.5 lb). Apparent consumption—not allowing for stock holding—was at 291.1 kg (640.4 lb).

Printing/writing papers shipments in the U.S. were up 5.9% to 18.6 million tons, reflecting the 6.9% growth in output of the printing and publishing industry and a 12% increase in the use of office copy papers. U.S. output of casemaking materials was 6.7% above 1986 at 23.12 million tons, with production destined for the domestic market increasing 7.5% and exports increasing 4.7% at 2.14 million tons.

Canada's industry recorded total shipments in 1987 of 24.3 million tons, or 98% of installed capacity. Newsprint, packaging, and market pulp sectors all operated at 98% or 99% of capacity. Printing/writing papers shipments increased 9% to 3.1 million tons, in line with fast-growing demand from the U.S. and Canada. Packaging paper and board shipments were 3,275,000 tons, an increase of 4% from 1986. Shipments of newsprint were up 4% to 9.7 million tons, and shipments into the U.S. and Canadian markets were up 5%. Market pulp exports were up 4%, or 300,000 tons.

In 1988, it seems likely that new output records will be established. GNP growth will probably be 2% to 2.5% for the year in both Canada and the U.S., and paper and board output and demand is expected to increase at approximately the same rate.

WORLD'S TOP 20 PRODUCING AND CONSUMING COUNTRIES

PAPER AND BOARD PRODUCTION
(000 metric tons)

	1986	% change 1986/85
1. U.S.	67,544	+5.0
2. Japan	22,537	+7.0
3. Canada	16,046	+5.1
4. People's Rep. China	11,411	+14.3
5. U.S.S.R.	11,036	+6.2
6. Fed. Rep. Germany	9,924	+5.5
7. Finland	8,012	+6.1
8. Sweden	7,811	+6.1
9. France	5,832	+4.3
10. Italy	4,987	+6.9
11. Brazil	4,678	+3.4
12. U.K.	4,183	+6.1
13. Spain	3,288	+4.3
14. Rep. Korea	3,163	+14.1
15. Taiwan	2,737	+8.3
16. Mexico	2,575	+4.3
17. Austria	2,357	+8.3
18. Netherlands	2,168	+6.9
19. India	1,886	+4.8
20. Australia	1,678	+2.2

PULP PRODUCTION
(000 metric tons)

	1986	% change 1986/85
1. U.S.	54,036	+4.5
2. Canada	23,021	+6.1
3. U.S.S.R.	11,610	+5.9
4. Sweden	9,973	+6.2
5. Japan	9,733	+5.3
6. Finland	8,467	+6.8
7. People's Rep. China	7,204	+9.4
8. Brazil	4,031	+0.9
9. Fed. Rep. Germany	2,259	+1.8
10. France	2,092	+3.5
11. Norway	1,889	−0.4
12. South Africa	1,840	−1.9
13. Spain	1,598	+6.3
14. Portugal	1.462	+4.1
15. Austria	1,333	−0.8
16. New Zealand	1,108	−0.2
17. Czechoslovakia	1,090	+0.4
18. India	1,050	+0.0
19. Australia	964	+10.8
20. Poland	964	+10.8

PER CAPITA CONSUMPTION
(lb/year)

	1986	% change 1986/85
1. U.S.	640	+0.4
2. Sweden	524	+3.9
3. Netherlands	488	+24.9
4. Canada	469	+1.2
5. Finland	444	−0.3
6. Switzerland	416	−0.7
7. Fed. Rep. Germany	407	−0.1
8. Denmark	403	−0.2
9. Japan	381	−0.2
10. Belgium	374	+0.0
11. New Zealand	352	+1.4
12. Hong Kong	326	−3.3
13. Australia	315	−1.5
14. U.K.	312	−0.1
15. Norway	312	−0.5
16. Taiwan	284	−1.3
17. Austria	279	−0.1
18. France	275	−0.7
19. Iceland	244	−0.1
20. Italy	207	+0.3

REVIEW OF TOP 20 NATIONS IN PULP/PAPER PRODUCTION

Australia

Population: 16,249,000. Per capita consumption of paper and board: 146 kg/321 lb. Paper and board mills: 18. Pulp mills: 19 (sulfate: 2; sulfite: 1; soda: 2; semichemical: 5; mechanical: 8; nonwood: 1).

Paper/board capacity: 2,035,000 tons **Pulp capacity:** 1,100,000 tons

(000 metric tons)

	Production		Imports		Exports	
	1986	**1987**	**1986**	**1987**	**1986**	**1987**
Paper	1,177	1,234	775	800	92	98
Board	465	444	—	—	—	7
Total	**1,642**	**1,678**	**775**	**800**	**92**	**105**
Chemical woodpulp	503	585	220	279	20	70
Mechanicals, other pulps	367	379	3	1	—	—
Total	**870**	**964**	**223**	**280**	**20**	**70**
Market pulp	—	—	—	—	—	—

Austria

Population: 7,571,700. Per capita consumption of paper and board: 132 kg/290 lb. Paper and board mills: 33. Pulp mills: 15 (sulfate: 3; sulfite: 7; semichemical: 1; mechanical: 5)

Paper/board capacity: 2,709,000 tons **Pulp capacity:** 1,603,000
Operating rate 1987: 87% **Operating rate 1987:** 83%

(000 metric tons)

	Production		Imports		Exports	
	1986	**1987**	**1986**	**1987**	**1986**	**1987**
Paper	1,832	1,989	318	338	1,303	1,449
Board	351	368	23	24	262	269
Total	**2,183**	**2,357**	**341**	**362**	**1,565**	**1,718**
Chemical woodpulp	1035	1,014	291	339	330	281
Mechanicals, other pulps	309	319	25	13	—	1
Total	**1,344**	**1,333**	**316**	**352**	**330**	**282**
Market pulp	408	363	316	352	330	282

Brazil

Population: 141,500,000. Per capita consumption of paper and board: 31 kg/68 lb. Paper and board mills: 146. Pulp mills: 38 (sulfate: 16; sulfite: 3; soda: 6; semichemical: 4; nonwood: 9).

Paper/board capacity: 5,364,000 tons **Pulp capacity:** 4,474,000 tons

(000 metric tons)

	Production		Imports		Exports	
	1986	**1987**	**1986**	**1987**	**1986**	**1987**
Paper	4,026	4,150	279	265	649	593
Board	499	528	2	3	43	16
Total	**4,525**	**4,678**	**281**	**268**	**692**	**609**
Chemical woodpulp	3,517	3,568	36	44	879	807
Mechanicals, other pulps	480	463	4	1	17	9
Total	**3,997**	**4,031**	**40**	**45**	**896**	**816**
Market pulp	1,536	1,507	40	45	896	816

Canada

Population: 25,600,000. Per capita consumption of paper and board: 218 kg/480 lb. Paper and board mills: 77. Pulp mills: 34.

Paper/board capacity: 16,520 tons **Pulp capacity:** 24,740 tons

(000 metric tons)

	Production		Imports		Exports	
	1986	**1987**	**1986**	**1987**	**1986**	**1987**
Paper	14,535	15,304	421	471	10,413	11,072
Board	726	742	219	229	66	80
Total	**15,261**	**16,046**	**640**	**700**	**10,479**	**11,152**
Chemical woodpulp	12,218	12,957	172	160	7,083	7,467
Mechanicals, other pulps	9,470	10,064	47	38	776	785
Total	**21,688**	**23,021**	**219**	**198**	**7,859**	**8,252**
Market pulp	7,366	8,013	—	—	6,690	7,106

China, People's Rep. of

Population: 1,080,000,000. Per capita consumption of paper and board: 12 kg/25 lbe. Paper and board mills: 5,000e Pulp mills: 9,000

Paper/board capacity: 12,500,000e tons **Pulp capacity:** 9,000,000. tons

(000 metric tons)

	Production		Imports		Exports	
	1986	**1987**	**1986**	**1987**	**1986**	**1987**
Paper	2,742	3,022e	175	221	104	127
Packaging paper/board	4,594	5,444e	878	1,101	163	190
Other paper/board	2,650	2,945e	165	14	40	3
Total	**9,986**	**11,411e**	**1,218**	**1,336**	**307**	**320**
Chemical woodpulp	942	994	483	638	—	—
Mechanical pulp	402	384e	26	26	—	—
Reed, bamboo, other pulps	5,239	5,826	67	19	—	—
Total	**6,583**	**7,204e**	**576**	**683**	**7**	**5**
Market pulp	196	196e	576	683	7	5

Finland

Population: 4,932,000. Per capita consumption or paper and board: 196 kg/431 lb. Paper and board mills: 46. Pulp mills: 47 (sulfate: 18; sulfite: 3; semichemical: 3; mechanical: 23)

Paper/board capacity: 8,590,000 tons **Pulp capacity:** 9,085,000 tons

(000 metric tons)

	Production		Imports		Exports	
	1986	**1987**	**1986**	**1987**	**1986**	**1987**
Paper	6,489	6,913	53	64	5,335	5,837
Board	1,060	1,090	20	21	828	900
Total	**7,549**	**8,003**	**73**	**85**	**6,163**	**6,737**
Chemical woodpulp	4,935	5,277	27	52	1,348	1,478
Mechanicals, other pulps	2,993	3,190	48	40	131	163
Total	**7,928**	**8,467**	**75**	**92**	**1,479**	**1,641**
Market pulp	1,819	2,027	75	92	1,479	1,641

France

Population: 55,800,000 Per capita consumption of paper and board: 130 kg/286 lb. Paper and board mills: 147. Pulp mills: 21 (sulfate 7; sulfite: 2; semichemical: 1; mechanical: 10; nonwood 1).

Paper/board capacity: 6,639,000 tons **Pulp capacity:** 2,240,000 tons

(000 metric tons)

	Production		Imports		Exports	
	1986	**1987**	**1986**	**1987**	**1986**	**1987**
Paper	5,065	5,277	2,239	2,406	1,291	1,454
Board	529	555	560	633	146	155
Total	**5,594**	**5,832**	**2,799**	**3,039**	**1,437**	**1,609**
Chemical woodpulp	1,585	1,623	1,641	1,633	340	398
Mechanicals, other pulps	437	469	128	132	5	6
Total	**2,022**	**2,092**	**1,769**	**1,765**	**345**	**404**
Market pulp	712	718	1,769	1,765	345	404

Germany, Fed. Rep.

Population: 61,150,000. Per capita consumption of paper and board: 191 kg/420 lb. Paper and board mills: 175. Pulp mills: 35 (sulfite: 8; semichemical: 1; mechanical: 24).

Paper/board capacity: 10,931,000 tons **Pulp capacity:** 2,490,000
Operating rate 1987: 93% **Operating rate 1987:** 91%

(000 metric tons)

	Production		Imports		Exports	
	1986	**1987**	**1986**	**1987**	**1986**	**1987**
Paper	8,468	8,949	4,471	4,711	2,463	2,793
Board	939	975	430	423	559	591
Total	**9,407**	**9,924**	**4,901**	**5,134**	**3,022**	**3,384**
Chemical woodpulp	816	826	3,009	3,134	127	140
Mechanicals, other pulps	1,403	1,433	67	66	—	—
Total	**2,219**	**2,259**	**3,076**	**3,200**	**127**	**140**
Market pulp	248	282	3,076	3,200	127	140

EUROPE

All of Europe, western and eastern, made more paper and board than ever before; it also used more. Output in 1987 was 71.7 million tons, up 5.4% from 1986, making a five-year run of annual records for a total increase of 23% since 1982. Apparent consumption has behaved in a similar fashion but at a slightly slower pace: 67.4 million tons in 1987, up 4.7% from 1986, continuing five years of record-breakers for a total increase of 19%. Demand for newsprint and other printing papers was particularly strong, beating many forecasts and confounding the predictions of oversupply. The growth of new capital investment in western Europe has continued apace in all paper and board sectors as well as in pulp.

Pulp production also continued to climb. In 1987, it totaled 47.2 million tons, up 4.7% from the previous year, while consumption just passed 50 million tons for the first time, up 5.2%. For both, 1987 was the fifth record year in a row.

Of the 12 nations of the European Community (EC), half had record production years to give a total paper and board output of 32.8 million tons, an increase of 5.7%. Notable among these was Belgium, which joined the million-ton club for the first time. The dominant producer, Fed. Rep. Germany, which makes one-third of the EC total, enjoyed yet another record year. However, it did not enjoy the effect of a strong currency on its export trade nor the advantages that it brought competing importers, who won more of an expanding home market than domestic mills. By contrast, export tonnage increased by 12% but by only 5% by value.

French pulp and paper mills had an excellent year, and both the amount of capital investment in new capacity and the level of foreign interest are increasing fast. What happens in France may mirror what is already happening in the U.K. It continued to enjoy its revival, particularly in the newsprint sector. As two more greenfield mills plus other expansions are planned, it is likely to become increasingly self-sufficient, although foreign ownership of the industry continues to increase as well. Italy moved out of the doldrums, and producers had a good year helped by a 10.5% rise in apparent consumption to a record level, though imports also increased. The slow process of restructuring, essentially fewer big mills owned by fewer companies, continues.

Spain and Portugal joined the EC in 1986, bringing significant new pulp capacity, over 3 million tons, mostly of popular eucalyptus pulp. While their pulp industries benefited from the increase in market prices in 1987, their paper industries are seeing rising consumption met by rising imports, made easier by EC membership. But this factor aside, Spain's paper mills have had three good years and further expansion is expected. Portugal, on the other hand, was one of the few countries where paper output declined in 1987, partly because of a rebuild at a major kraftliner producer. However, several expansion programs are being planned.

"Full capacity utilization" was the most common term used to describe 1987 for the three Nordic nations, which depend strongly on their exports of forest products. Finland crossed 8 million tons of paper and board output for the first time, and Sweden is expected to do so this year. By contrast, Norway's output has stayed around 1.6 million tons for the last three years, and for some sectors output was limited by capacity.

Strong demand on world markets, particularly the EC, for main exports (pulp, newsprint, printing/writing papers, and kraftliner) meant their mills had a highly productive and profitable year. In both countries, a period of mergers and acquisitions is resulting in larger, more internationally competitive companies, most of which are undertaking considerable expansion in pulp and papermaking capacity. These countries are additionally continuing the process of buying into the EC's papermaking and paper-distribution chain, in preparation—along with some trepidation—for the single open internal market planned by the EC for 1992.

Austria too is concerned about this development, as it also depends on this market for its exports. Last year was its eleventh record year in a row, though each annual increase has been modest. Further expansions are being completed, such that the export trade will become more important. Partly for this reason, a lobby group in Austria wants it to apply for EC membership.

The fact that the three Nordic nations alone make nearly as much as all the eastern European nations, including the U.S.S.R., reflects both the Nordic dynamism and the difficulties facing some of the eastern Europeans. Shortages of raw materials and economic problems have kept capital investment low in this industry for most of these countries. However, they should not be underrated in the future, as the potential exists for higher output as soon as conditions permit.

One exception is the U.S.S.R. Preliminary figures indicate output once again reached a record level, and several capital investment projects are planned, some with foreign partners.

ASIA/AUSTRALASIA

Output of paper and board in Asia/Australasia grew to a record level of 45.1 million tons in 1987, up 9.8% from 1986. Output of pulp from this region was over 20 million tons for the first time, a rise of 6.4%.

It was a momentous year. Japan, Rep. Korea, Taiwan, and China recorded impressive increases in production. Meanwhile, New Zealand and Australia began a major phase of expansion and restructuring, and Indonesia and Thailand began to exploit their natural forest resources.

Japan is by far the region's major producer, making nearly 50% of the paper and board and 48% of the pulp. In 1987, Japan's domestic economy grew faster than expected, with GNP up by 4.2% in real terms from 1986. Domestic demand for paper and board was even better, rising by 7.2%. Advertising for consumer goods fueled paper demand, and board demand was helped by an upswing in containerboard packaging.

Despite the surge in the value of the yen against the

TOP 20 PRODUCING NATIONS

India

Population: 700,000,000. Per capita consumption of paper and board: 2 kg/5 lb. Paper and board mills: 300. Pulp mills: 1.

Paper/board capacity: 2,760,000 tons **Pulp capacity:** —
Operating rate 1987: 68 % **Operating rate 1987:** — %

(000 metric tons)

	Production		Imports		Exports	
	1986	1987	1986	1987	1986	1987
Paper	1,100	1,136	194	189	—	—
Board	700	750	—	—	—	—
Total	**1,800**	**1,886**	—	—	—	—
Chemical woodpulp	—	—	—	—	—	—
Mechanicals, other pulps	—	—	—	—	—	—
Total	—	—	—	—	—	—
Market pulp	30	15	290	300	—	—

Italy

Population: 57,319,000. Per capita consumption of paper and board: 104 kg/229 lb. Paper and board mills: 340. Pulp mills: 21 (sulfite: 2; semichemical: 3; mechanical: 15; nonwood: 1).

Paper/board capacity: 5,300,000 tons **Pulp capacity:** 850,000 tons

(000 metric tons)

	Production		Imports		Exports	
	1986	1987	1986	1987	1986	1987
Paper	3,778	4,033	1,635	1,920	890	949
Board	887	954	157	204	186	214
Total	**4,665**	**4,987**	**1,792**	**2,124**	**1,076**	**1,163**
Chemical woodpulp	205	218	1,712	1,938	50	36
Mechanicals, other pulps	506	519	110	147	3	8
Total	**711**	**737**	**1,822**	**2,085**	**53**	**44**
Market pulp	230	250	1,822	2,085	53	44

Japan

Population: 122,000,000. Per capita consumption of paper and board: 185 kg/407 lb. Paper and board mills: 489. Pulp mills: 61 (sulfate: 37; sulfite: 4; semichemical: 9; mechanical: 27; nonwood: 3).

Paper/board capacity: 25,286,000 tons **Pulp capacity:** 12,571,000 tons

(000 metric tons)

	Production		Imports		Exports	
	1986	1987	1986	1987	1986	1987
Paper	18,238	19,535	815	818	638	608
Board	2,824	3,001	38	47	202	206
Total	**21,062**	**22,536**	**853**	**865**	**840**	**814**
Chemical woodpulp	7,176	7,606	1,868	2,029	37	15
Mechanicals, other pulps	2,036	2,126	694	700	2	1
Total	**9,212**	**9,732**	**2,562**	**2,729**	**39**	**16**
Market pulp	937	956	2,562	2,729	39	16

Korea, Rep. of

Population: 42,082,000. Per capita consumption of paper and board: 70 kg/153 lb. Paper and board mills: 150e. Pulp mills: 5 (sulfate: 1; mechanical: 4).

Paper/board capacity: 3,421,000 tons **Pulp capacity:** 427,000 tons

(000 metric tons)

	Production		Imports		Exports	
	1986	1987	1986	1987	1986	1987
Paper	2,207	2,506	123	158	105	116
Board	567	656	5	6	176	282
Total	**2,774**	**3,162**	**128**	**164**	**281**	**398**
Chemical woodpulp	144	147	677	739	0	0
Mechanicals, other pulps	143	168	63	60	0	0
Total	**287**	**315**	**740**	**799**	**0**	**0**
Market pulp	144	147	740	799	0	0

Mexico

Population: 82,000,000. Per capita consumption of paper and board: 29 kg/64 lb. Paper and board mills: 64. Pulp mills: 15 (sulfate: 8; mechanical 2; nonwood: 5).

Paper/board capacity: 3,337,000 tons **Pulp capacity:** 947,000 tons

(000 metric tons)

	Production		Imports		Exports	
	1986	1987	1986	1987	1986	1987
Paper	2,199	2,299	68	61	135	243
Board	271	276	3	5	—	—
Total	**2,470**	**2,575**	**71**	**66**	**135**	**243**
Chemical woodpulp	422	438	312	454	—	20
Bagasse/straw	228	227	—	—	—	—
Mechanical, other pulps	124	134	33	25	—	—
Total	**774**	**799**	**345**	**479**	—	**20**
Market pulp	265	—	—	—	—	—

Netherlands

Population: 11,661,000. Per capita consumption of paper and board: 181 kg/398 lb. Paper and board mills: 32. Pulp mills: 3 (mechanical: 2; nonwood: 1).

Paper/board capacity: 2,333,000 tons **Pulp capacity:** 198,000
Operating rate 1987: 94 % **Operating rate 1987:** 68 %

(000 metric tons)

	Production		Imports		Exports	
	1986	1987	1986	1987	1986	1987
Paper	1,375	1,495	1,514	1,580	887	1,028
Board	654	673	320	338	387	411
Total	**2,029**	**2,168**	**1,834**	**1,918**	**1,274**	**1,439**
Chemical woodpulp	0	0	568	561	24	31
Mechanicals, other pulps	133	135	25	26	2	3
Total	**133**	**135**	**593**	**587**	**26**	**34**
Market pulp	—	—	—	—	—	—

Spain

Population: 39,310,648. Per capita consumption of paper and board: 90 kg/198 lb. Paper and board mils: 163. Pulp mills: 26 (sulfate: 24; sulfite: 1; mechanical: 5; nonwood: 6).

Paper/board capacity: 3,600,000 tons **Pulp capacity:** 1,720,000 tons

(000 metric tons)

	Production		Imports		Exports	
	1986	1987	1986	1987	1986	1987
Paper	2,812	2,931	617	689	343	405
Board	340	357	40	54	93	103
Total	**3,152**	**3,288**	**657**	**743**	**436**	**508**
Chemical woodpulp	1,301	1,377	435	419	428	506
Mechanicals, other pulps	203	219	9	9	6	7
Total	**1,504**	**1,596**	**444**	**428**	**434**	**513**
Market pulp	706	803	444	428	434	513

Sweden

Population: 8,400,000. Per capita consumption of paper and board: 233 kg/513 lb. Paper and board mills: 55. Pulp mills: 55 (sulfate: 25; sulfite: 7; semichemical: 2; mechanical: 21).

Paper/board capacity: 8,210,000 tons **Pulp capacity:** 10,490,000 tons

(000 metric tons)

	Production		Imports		Exports	
	1986	1987	1986	1987	1986	1987
Paper	6,152	6,582	192	203	4,707	5,084
Board	1,211	1,229	77	85	929	1,010
Total	**7,363**	**7,811**	**269**	**288**	**5,636**	**6,094**
Chemical woodpulp	6,669	7,001	154	139	2,352	2,416
Mechanicals, other pulps	2,726	2,972	4	5	589	619
Total	**9,395**	**9,973**	**158**	**144**	**2,941**	**3,035**
Market pulp	3,436	3,526	—	—	2,941	3,035

TOP 20 PRODUCING NATIONS

Taiwan

Population: 19,725,000. Per capita consumption of paper and board: 144 kg/317 lb. Paper and board mills: 152. Pulp mills: 3 (sulfate: 2; nonwood: 1).

Paper/board capacity: 3,170,000 tons
Operating rate 1987: 86 %

Pulp capacity: 500,000 tons
Operating rate 1987: 83 %

(000 metric tons)

	Production		Imports		Exports	
	1986	**1987**	**1986**	**1987**	**1986**	**1987**
Paper	1,917	2,091	156	234	69	68
Board	610	646	12	54	80	78
Total	**2,527**	**2,737**	**168**	**288**	**149**	**146**
Chemical woodpulp	314	331	282	335	79	65
Bleached bagasse	70	73	—	—	28	16
Mechanicals, other pulps	11	12	32	44	1	1
Total	**394**	**416**	**314**	**379**	**108**	**82**
Market pulp	326	328	314	379	108	82

United Kingdom

Population: 56,650,000. Per capita consumption of paper and board: 154 kg/339 lb. Paper and board mills: 93. Pulp mills: 6 (semichemical: 2; mechanical: 2; nonwood: 2).

Paper/board capacity: 4,351,000 tons
Operating rate 1987: 96 %

Pulp capacity: 490,000 tons
Operating rate 1987: 80 %

(000 metric tons)

	Production		Imports		Exports	
	1986	**1987**	**1986**	**1987**	**1986**	**1987**
Paper	2,872	3,074	3,817	4,232	367	410
Other paper/board	1,069	1,110	940	1,051	263	322
Total	**3,941**	**4,184**	**4,757**	**5,283**	**630**	**732**
Chemical woodpulp	—	—	1,465	1,737	3	1
Mechanicals, other pulps	—	—	222	203	2	3
Total	**399**	**389**	**1,687**	**1,940**	**5**	**4**
Market pulp	—	—	—	—	—	—

United States

Population: 243,773,000. Per capita consumption of paper and board: 303 kg/666 lb. Paper and board mills: 555. Pulp mills: 219 (sulfate: 117; sulfite: 13; semichemical: 39; mechanical: 65).

Paper/board capacity: 70,780 tons
Operating rate 1987: 95 %

Pulp capacity: 55,170 tons
Operating rate 1987: 98 %

(000 metric tons)

	Production		Imports		Exports	
	1986	**1987**	**1986**	**1987**	**1986**	**1987**
Paper	53,844	56,646	10,256	10,864	2,847	2,978
Board	10,464	10,899	95	137	842	1,079
Total	**64,308**	**67,545**	**10,351**	**11,001**	**3,689**	**4,057**
Chemical woodpulp	45,607	47,663	3,878	.4138	3,378	3,749
Mechanicals, other pulps	6,119	6,374	278	263	667	687
Total	**51,726**	**54,037**	**4,156**	**4,401**	**4,045**	**4,436**
Market pulp	6,879	7,374	2,832	2,935	4,055	4,373

U.S.S.R.

Population: 275,000,000. Per capita consumption of paper and board: 40 kg/88 lbe. Paper and board mills: 84. Pulp mills: 57.

Paper/board capacity: 11,500,000e tons **Pulp capacity:** 10,000,000e tons

(000 metric tons)

	Production		Imports		Exports	
	1986	**1987**	**1986**	**1987**	**1986**	**1987**
Paper	6,156	6,435e	512	520e	688	700
Board	4,239	4,601e	102	105e	471	475
Total	**10,395**	**11,036e**	**614**	**625e**	**1,159**	**1,175**
Chemical woodpulp	9,363e	9,910e	—	—	1,105	1,105
Mechanicals, other pulps	1,600e	1,700e	—	—	—	—
Total	**10,963e**	**11,610e**	**350**	**350e**	**1,105**	**1,105**
Market pulp	—	—	—	—	—	—

dollar, the level of imports was flat at around 866,000 tons. The reasons were tight world markets in many grades plus soft prices on the domestic market, which discouraged importers. Domestic pulp production was up 5.4%, to 9.73 million tons. Pulp imports increased sharply, however, by 8.5%.

Japanese companies have invested heavily to improve efficiency, with capital spending concentrated on newsprint and coated paper lines. Companies are also now increasing their investments overseas, with North America the main target for investment. In the past, investments have taken the form of joint ventures, but companies are now more likely to buy and manage their own subsidiaries or to build their own mills.

People's Rep. China overtook the U.S.S.R. to become the world's fourth-largest producer of paper and board in 1987. Its output passed the 11-million-ton mark for the first time, reaching 11.4 million tons, up from only 9.99 million tons in 1986. China's target for the next 15 to 25 years is to reach a per capita consumption of 40 kg (88 lb), up from the present 11.5 kg (25.3 lb) average. The current levels of investment spending imply that this is a realistic goal.

Rep. Korean producers produced 3.16 million tons of paper and board in 1987, an increase of 14.1% from 1986. However, the year was not problem-free. Steadily rising market pulp prices, plus political reform that led to strikes and eventually to high wage settlements, severely impaired company profitability. And the Rep. Korean currency, the won, rose steadily against the dollar, hurting the ability of producers to export their products. Also, a faster-than-expected relaxation in import duties exposed the industry to added competition on the domestic market and led to restructuring, especially in the board sector, as producers switched from waste-based linerboard to duplex and coated grades.

Growth in output in Taiwan was a lower-than-expected 8.5%, or 2.74 million tons. The reasons were the slowdown in export trade as the Taiwanese dollar rose against the U.S. dollar, higher imports as a result of lower tariff barriers, and a delay in the deregulation of newspapers, which hit demand for newsprint. Despite these setbacks, investment by the domestic industry is continuing apace and is expected to rise in 1988.

The major Australasian nations, Australia and New Zealand, embarked on a new phase of development in 1987, with restructuring and investment at home and abroad the key words. Australian output was a relatively flat 1.68 million tons, up 2.1%. However, the list of investments planned by the major companies is impressive. They include a 400,000-tpy bleached eucalyptus pulp mill to be built by APPM together with the Canadian Noranda group; a newsprint paper machine to be built by ANM at its Albury, Australia, mill; and another possible eucalyptus pulp mill to be built by APM Ltd. with international partners.

Expansion by acquisition was also important, with North American purchases particularly notable. Smorgon Consolidated Industries bought FSG Paper's newsprint mill in Chicago, Ill., while the Pratt Group bought the Georgia Kraft Co. linerboard mill. Rumors are that Amcor, the parent of APM, will be next to buy into North America.

In New Zealand, paper and board output fell 4% to 644,000 tons, mainly due to a major earthquake in March, which shut down all three of Tasman Pulp and Paper Co. Ltd.'s newsprint paper machines (total capacity 330,000 tpy) as well as its 170,000-tpy market pulp line. Despite this, pulp output was 1.11 million tons in 1987.

Restructuring and investment were the strong features of 1987, and New Zealand's biggest industrial company, Fletcher Challenge, was at the center of events. It bought 100% of the 70,000-tpy Bío-Bío newsprint mill in Chile and increased its majority shareholdings in Canada's Crown Forest Products and BCFP (recently, the group has decided to merge its Canadian operations). At home, Fletcher Challenge won control of Winstone Pulp Industries' 200,000-tpy CTMP mill but lost its battle for control of New Zealand Forest Products, the latter being sold after a long series of takeover attempts to Elders Resources of Australia. Recently, Fletcher Challenge bought up 50% of Australia's newsprint manufacturer ANM and half of Pisa, the Brazilian newsprint producer.

Expansion can also be expected among New Zealand's other companies. Now that NZFP's future has been decided, a big investment program at its Kinleith mill will raise capacity by 130,000 tpy of paper and board. And Caxton Paper Mills Ltd. is also considering a new kraft pulp line for the early 1990s, as well as a new CTMP line.

1987 was a good year for two Asian countries—Indonesia and Thailand. In Indonesia, long-awaited capital spending projects are now under way, including a new integrated sack kraft and linerboard mill in northern Sumatra, a greenfield dissolving and paper-grade pulp mill (also in northern Sumatra), and a new coated paper line. Overall, the country's output has risen strongly, and exports are growing fast.

Perhaps the only bleak spots in Asia this year are the countries of the Indian subcontinent. Chronic problems of poor fiber supply, expensive power, and labor unrest will have to be overcome before the full potential of these countries can be met. Even so, Indian production of paper and board did improve to 1.89 million tons in 1987, up 5% from 1986.

LATIN AMERICA

Optimism is a key word of the Latin American pulp and paper industry in mid-1988. In Brazil, Chile, Argentina, Venezuela, and Colombia, the outlook for the pulp and paper industry has rarely been so bright in the past few years. Despite the profound economic difficulties facing these countries, total output and consumption of pulp and paper are rising strongly and imports are relatively static. Equally important to the future of the industry, major expansion projects that had long been gathering dust now seem set to become reality, some of them with help from foreign capital.

Having broken through the 10-million-ton barrier for the first time in 1986, paper and board output from the continent's producers grew by 5%—or just over a half-million tons—in 1987. Total consumption of paper and board was over 11 million tons, a rise of 5.1%. The growth in pulp output was a more modest 1.9% to 6.99 million tons.

Brazil is by far the major producer, accounting for 44.5% of all paper and board produced in Latin America as well as 57.7% of its pulp output. Last year was another chaotic one for the country's economy, with record inflation of 360%, rising taxes, GNP growth of only 2%, and some tough bargaining on rescheduling the $120-billion foreign debt. But positive signs for the future are the balance of payments surplus, which was a steady $1 million/month in 1987, and plans to convert the huge debt into venture capital, freeing funds for industrial investment.

Official Brazilian government financing agencies are planning to spend $5.06 billion in the next four years on pulp capacity expansions. Besides those at Aracruz Celulose, Cenibra, and Riocell, new projects have come to the fore, including Proin, a joint venture between 11 nonintegrated mills to build their own pulp mill; Copener, an energy company that has large plantations of eucalyptus originally grown for fuel but, with falling oil prices, now considered more suitable for pulping; and a reactivation of the Guatapara project by Grupo Votorantin. Also, a joint venture between CVRD and Suzano will build a new 350,000-tpy eucalyptus pulp mill in Bahia do Sul. If these projects proceed (and it is likely that several will) the net addition to Brazil's pulp capacity will be over 3 million tpy by the end of 1992. New paper machine announcements can be expected.

Expansion is the key word in Chile as well, much of it funded with foreign capital. Three important new market pulp lines, two softwood and one hardwood, are scheduled for startup by the end of 1992. U.S. capital is involved in one of the softwood lines, a new $500-million, 315,000-tpy greenfield pulp mill near Nacimiento to be built by CMPC in cooperation with Simpson Paper Co. of California. Simpson will hold a 50% share in the project. Celulosa Arauco y Constitucion is also planning a new $450-million, 750-tpd pulp line at its Arauco mill. Both of these facilities will use Chilean radiata pine as raw material.

Although the first major investment is still being awaited, Argentina is beginning to attract investor attention. An emerging stable democracy and modest improvements seem to be spurring their interest. Domestic companies are embarking on expansion projects meanwhile. Two of them, Celulosa Puerto Piray's 210,000-tpy bleached softwood kraft mill and the Cuatiara project, will on completion raise the country's softwood pulp output by 50% and double its capacity of printing/writing papers.

Expansion fever is also apparent in Venezuela. All of the major domestic mills have plans to raise output, and foreign investment is again entering the country. This time Abitibi-Price Inc. of Canada, Bowater Inc. of the U.S., the Venezuelan government, and Venezuelan publishers have signed a letter of intent to build a 200,000-tpy newsprint machine for startup in 1991.

WORLD PULP, PAPER, AND BOARD INDUSTRY AT A GLANCE

Continent/ country	Population (1,000)	Number of mills		Capacity (1,000 tons)		Per capita (lb)	Apparent consumption (1,000 tons)				Production (1,000 tons)			
							P&B		Pulp		P&B		Pulp	
		P&B	Pulp	P&B	Pulp		1986	1987	1986	1987	1986	1987	1986	1987
EUROPE														
Belgium[1]	10,000	14	2	1,120	450	375	1,703	1,862	597	710	850	1,029	304	382
Denmark	5,200	11	3	350	145	404	954	1,022	146	135	333	323	95	81
France	55,800	147	21	6,639	2,240	274	6,956	7,262	3,446	3,453	5,594	5,832	2,022	2,092
Germany, Fed. Rep.	61,150	175	35	10,931	2,490	406	11,286	11,674	5,168	5,319	9,407	9,924	2,219	2,259
Greece	9,700	22	2	470	65	132	583	640	217	230	373	416	26	50
Ireland	3,595	2	0	50	0	176	288	320	11	15	15	30	0	0
Italy	57,319	340	21	5,300	850	207	5,381	5,948	2,480	2,775	4,665	4,987	711	734
Netherlands	11,661	32	3	2,333	198	488	2,589	2,647	700	688	2,029	2,168	133	135
Portugal	10,230	94	8	805	1,390	126	587	602	438	452	665	627	1,405	1,462
Spain	39,311	163	26	3,600	1,720	189	3,372	3,570	1,514	1,515	3,153	3,288	1,504	1,598
United Kingdom	56,650	93	6	4,351	490	313	8,068	8,734	2,081	2,325	3,941	4,183	399	389
EEC	**320,616**	**1,093**	**127**	**35,949**	**10,038**	**287**	**41,767**	**44,281**	**16,798**	**17,617**	**31,025**	**32,807**	**8,818**	**9,182**
Finland	4,932	46	47	8,590	9,085	444	995	904	6,524	6,918	7,549	8,012	7,928	8,467
Norway	4,180	19	24	1,850	2,125	312	593	569	1,393	1,382	1,573	1,590	1,896	1,889
Sweden	8,400	55	55	8,210	10,490	523	1,998	2,005	6,612	7,082	7,363	7,811	9,395	9,973
Nordic	**17,512**	**120**	**126**	**18,650**	**21,700**	**451**	**3,586**	**3,478**	**14,529**	**15,382**	**16,485**	**17,413**	**19,219**	**20,329**
Austria	7,572	33	15	2,709	1,603	279	959	1,001	1,330	1,408	2,183	2,357	1,344	1,333
Iceland	244	0	0	0	0	244	27	27	0	0	0	0	0	0
Malta	355	0	0	0	0	62	10	10	0	0	0	0	0	0
Switzerland	6,566	29	6	1,150	365	416	1,243	1,327	594	596	1,087	1,147	310	324
Other W. Europe	**14,737**	**62**	**21**	**3,859**	**1,968**	**334**	**2,239**	**2,365**	**1,924**	**2,004**	**3,270**	**3,504**	**1,654**	**1,657**
Total W. Europe	**352,865**	**1,275**	**274**	**58,458**	**33,706**	**297**	**47,592**	**50,124**	**33,251**	**35,003**	**50,780**	**53,724**	**29,691**	**31,168**
Albania	2,970	4	4	15	15	13	17	17	10	10	10	10	10	10
Bulgaria	9,000	15	9	520	260	108	440	440	270	270	350	350	220	220
Czechoslovakia	15,587	38	23	1,261	1,223	165	1,167	1,181	736	740	1,247	1,261	[illegible]	1,090
German, Dem. Rep.	16,640	21	19	1,500	750	183	1,381	1,356	811	835	1,327	1,339	674	672
Hungary	10,100	10	5	550	150	149	686	668	249	272	517	522	62	69
Poland	37,800	48	21	1,500	1,086	80	1,370	1,391	1,007	1,090	1,320	1,375	876	906
Romania	22,820	20	12	850	750	68	710	728	650	660	750	768	600	610
USSR	275,000	84	57	11,500	10,000	79	9,850	10,486	10,208	10,855	10,395	11,036	10,963	11,610
Yugoslavia	23,000	30	21	1,600	950	116	1,210	1,055	936	879	1,350	1,307	840	800
E. Europe	**412,917**	**270**	**171**	**19,296**	**15,184**	**90**	**16,831**	**17,322**	**14,877**	**15,611**	**17,266**	**17,968**	**15,331**	**15,987**
Total Europe	**765,782**	**1,545**	**445**	**77,754**	**48,890**	**185**	**64,423**	**67,446**	**48,128**	**50,614**	**68,046**	**71,692**	**45,022**	**47,155**
NORTH AMERICA														
Canada	25,600	77	34	16,520	24,740	469	5,461	5,594	14,048	14,967	15,261	16,046	21,688	23,021
United States	243,773	555	219	70,780	55,170	640	70,969	74,488	51,837	54,000	64,307	67,544	51,726	54,036
North America	**269,373**	**632**	**253**	**87,300**	**79,910**	**624**	**76,430**	**80,082**	**65,885**	**68,967**	**79,568**	**83,590**	**73,414**	**77,057**
ASIA														
Afghanistan	16,000	0	0	0	0	<1	2	2	0	0	0	0	0	0
Bangladesh	105,000	8	9	127	126	2	114	117	95	99	113	115	75	83
Bahrain	400	0	0	0	0	33	6	6	0	0	0	0	0	0
Bhutan	1,400	0	0	0	0	2	1	1	0	0	0	0	0	0
Brunei	200	0	0	0	0	33	3	3	0	0	0	0	0	0
Burma	37,850	3	2	31	30	3	44	47	25	27	24	27	27	29
China, Peo. Rep.[2]	1,080,000	50	50	12,500	9,000	22	10,897	12,427	7,152	7,882	9,986	11,411	6,583	7,204
Cyprus	650	1	0	10	0	108	32	37	1	1	2	2	0	0
Hong Kong	5,500	2	0	15	0	325	812	812	0	0	12	12	0	0
India	700,000	300	100	2,760	1,450	6	2,050	2,136	1,340	1,350	1,800	1,886	1,050	1,050
Indonesia	165,150	36	16	980	442	10	762	794	505	500	642	775	250	270
Iran	50,000	6	2	300	188	15	335	422	82	75	120	105	66	60
Iraq	15,500	2	2	144	90	10	70	65	47	33	30	25	30	14
Israel	4,500	5	0	170	0	198	404	471	66	68	159	174	0	0
Japan	122,000	489	61	25,286	12,571	380	21,078	22,589	11,765	12,448	21,062	22,537	9,240	9,733
Jordan	3,600	3	0	18	0	39	64	78	11	12	14	14	0	0
Kampuchea	6,200	0	0	0	0	<1	2	2	0	0	0	0	0	0
Korea, Peo. Rep.	20,000	6	2	100	80	9	80	80	70	70	80	80	60	60
Korea, Rep.	42,082	150	5	3,421	427	137	2,620	2,929	1,027	1,114	2,773	3,163	287	315
Kuwait	1,910	1	0	25	0	105	91	91	10	10	23	23	0	0
Laos	4,000	0	0	0	0	<1	1	1	0	0	0	0	0	0
Lebanon	2,700	3	0	50	0	61	75	75	5	5	15	15	0	0
Macao	300	0	0	0	0	29	4	4	0	0	0	0	0	0
Malaysia	15,790	13	1	220	92	60	429	455	17	32	70	70	10	10
Mongolia	1,950	1	1	10	6	23	20	20	5	5	5	5	5	5
Nepal	17,576	2	2	7	7	2	18	19	3	5	3	5	3	5
Oman	1,200	0	0	0	0	11	6	6	0	0	0	0	0	0
Pakistan	88,880	15	3	160	100	7	277	344	109	116	106	98	85	75
Philippines	56,000	23	3	515	208	15	372	445	120	123	254	308	121	146
Qatar	300	0	0	0	0	73	10	10	0	0	0	0	0	0
Saudi Arabia	9,000	0	0	0	0	24	100	100	0	0	0	0	0	0
Singapore	2,500	2	0	31	0	195	222	220	6	6	10	10	0	0
Sri Lanka	15,000	2	2	27	26	11	77	77	12	15	27	27	7	6
Syria	10,500	12	12	6	6	17	80	80	5	5	5	5	5	5
Taiwan	19,725	152	3	3,170	500	284	2,545	2,880	600	713	2,527	2,737	394	416
Thailand	52,000	33	5	720	150	27	630	715	176	200	478	560	117	150
Turkey	52,500	39	17	1,100	550	29	699	880	534	540	661	840	454	450
United Arab Emirates	1,000	0	0	0	0	15	7	7	0	0	0	0	0	0
Vietnam	60,000	30	1	120	35	2	66	66	55	55	60	60	25	25
Yemen Arab Rep.	6,000	0	0	0	0	<1	2	2	0	0	0	0	0	0
Yemen Dem. Rep.	2,200	0	0	0	0	2	2	2	0	0	0	0	0	0
Asia	**2,797,063**	**1,389**	**299**	**52,023**	**26,084**	**35**	**45,109**	**49,517**	**23,843**	**25,509**	**41,061**	**45,089**	**18,894**	**20,111**

Note: some figures are estimates. See individual country listings for details.

1. Import figures are for Belgium-Luxembourg. 2. People's Rep. China has an approximate total of 5,000 paper mills and 9,000 pulp mills. Only those with a capacity figure greater than 30,000 tpy are included here.

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Continent/ country	Population (1,000)	Number of mills		Capacity (1,000 tons)		Per capita (lb)	Apparent consumption (1,000 tons)				Production (1,000 tons)			
		P&B	Pulp	P&B	Pulp		P&B		Pulp		P&B		Pulp	
							1986	1987	1986	1987	1986	1987	1986	1987
LATIN AMERICA														
Argentina	31,000	100	25	1,300	900	75	1,058	1,140	701	708	991	1,064	723	725
Bahamas	200	0	0	0	0	165	15	15	0	0	0	0	0	0
Barbados	300	0	0	0	0	51	7	7	0	0	0	0	0	0
Belize	200	0	0	0	0	33	3	3	0	0	0	0	0	0
Bolivia	6,200	1	0	2	0	7	21	21	0	0	1	1	0	0
Brazil	141,500	146	38	5,364	4,474	64	4,114	4,337	3,141	3,260	4,525	4,678	3,997	4,031
Chile	12,327	7	7	423	876	53	296	350	285	338	388	442	848	861
Colombia	30,346	24	5	560	264	38	528	573	281	293	457	488	234	247
Costa Rica	2,655	2	1	18	25	99	120	122	7	7	12	12	6	6
Cuba	10,105	9	3	150	60	71	325	325	90	90	125	125	40	40
Dominican Rep	6,588	2	0	15	0	22	65	64	4	4	9	9	0	0
Ecuador	10,000	5	1	65	35	13	59	97	6	17	59	67	6	6
El Salvador	5,072	3	0	50	0	29	67	67	12	12	29	29	0	0
Guatemala	8,070	4	1	50	0	26	95	95	5	5	35	35	0	0
Guyana	800	0	0	0	0	19	7	7	0	0	0	0	0	0
Haiti	5,800	0	0	0	0	2	6	6	0	0	0	0	0	0
Honduras	4,500	0	0	0	0	14	29	29	0	0	0	0	0	0
Jamaica	2,100	1	0	15	0	44	42	43	1	1	12	13	0	0
Mexico	82,000	64	15	3,337	947	64	2,405	2,398	1,117	1,259	2,470	2,575	772	800
Neth. Antilles	300	0	0	0	0	22	3	3	0	0	0	0	0	0
Nicaragua	3,000	0	0	0	0	18	24	24	0	0	0	0	0	0
Panama	2,038	3	0	30	0	90	83	83	1	1	28	28	0	0
Paraguay	3,722	3	0	25	0	15	26	26	0	0	13	13	0	0
Peru	20,207	14	3	361	311	27	250	285	178	217	184	214	122	145
Surinam	400	0	0	0	0	61	11	11	0	0	0	0	0	0
Trinidad/Tobago	1,200	0	0	0	0	62	34	34	0	0	0	0	0	0
Uruguay	3,000	5	2	83	27	37	51	54	33	36	54	48	24	26
Venezuela	19,000	12	3	791	175	89	768	833	308	396	612	675	88	101
Latin America	**412,630**	**405**	**104**	**12,639**	**8,094**	**56**	**10,512**	**11,052**	**6,170**	**6,644**	**10,004**	**10,516**	**6,860**	**6,988**
AUSTRALASIA														
Australia	15,249	18	19	2,035	1,100	315	2,325	2,373	1,073	1,174	1,642	1,678	870	964
Fiji	700	0	0	0	0	22	7	7	0	0	0	0	0	0
New Zealand	3,284	6	7	807	1,437	352	525	599	629	816	671	644	1,110	1,108
Papua New Guinea	3,500	0	0	0	0	4	6	6	0	0	0	0	0	0
Samoa	200	0	0	0	0	33	3	3	0	0	0	0	0	0
Australasia	**23,933**	**24**	**26**	**2,842**	**2,537**	**264**	**2,866**	**2,988**	**1,702**	**1,990**	**2,313**	**2,322**	**1,980**	**2,072**
AFRICA														
Algeria	22,025	6	3	160	170	18	180	180	95	95	110	110	35	35
Angola	7,950	2	1	30	45	5	19	19	15	15	15	15	15	15
Benin	4,000	0	0	0	0	2	4	4	0	0	0	0	0	0
Botswana	1,100	0	0	0	0	2	1	1	0	0	0	0	0	0
Burkina Faso	6,900	0	0	0	0	<1	1	1	0	0	0	0	0	0
Burundi	5,000	0	0	0	0	2	4	4	0	0	0	0	0	0
Cameroon	9,800	0	0	0	0	2	10	10	0	0	0	0	0	0
Central African Rep	2,700	0	0	0	0	<1	1	1	0	0	0	0	0	0
Chad	5,200	0	0	0	0	<1	1	1	0	0	0	0	0	0
Congo	1,800	0	0	0	0	1	1	1	0	0	0	0	0	0
Egypt	49,000	16	3	180	80	24	522	550	90	100	147	160	60	70
Ethiopia	42,290	1	0	15	0	1	20	21	4	4	10	11	0	0
Gabon	900	0	0	0	0	5	2	2	0	0	0	0	0	0
Gambia	800	0	0	0	0	6	2	2	0	0	0	0	0	0
Ghana	13,200	0	0	0	0	2	9	9	0	0	0	0	0	0
Guinea	5,700	0	0	0	0	2	4	4	0	0	0	0	0	0
Ivory Coast	10,180	7	0	80	0	26	121	123	83	124	44	46	0	0
Kenya	23,000	5	6	103	100	10	107	119	74	100	96	106	70	96
Lesotho	1,500	0	0	0	0	2	1	1	0	0	0	0	0	0
Liberia	2,200	0	0	0	0	1	1	1	0	0	0	0	0	0
Libya	4,000	10	0	10	0	8	14	14	6	6	6	6	0	0
Madagascar	10,000	2	2	28	7	2	11	8	9	7	11	8	5	4
Malawi	7,900	0	0	0	0	2	9	9	0	0	0	0	0	0
Mali	7,700	0	0	0	0	<1	1	1	0	0	0	0	0	0
Mauritania	1,700	0	0	0	0	5	4	4	0	0	0	0	0	0
Mauritius	1,000	0	0	0	0	13	6	6	0	0	0	0	0	0
Morocco	24,800	8	1	126	100	16	181	184	32	53	109	115	81	101
Mozambique	13,776	2	0	10	0	3	17	17	3	1	2	2	0	0
Niger	6,500	0	0	0	0	1	3	3	0	0	0	0	0	0
Nigeria	95,000	5	2	170	140	9	403	403	44	51	77	79	32	39
Rwanda	4,600	0	0	0	0	2	5	5	0	0	0	0	0	0
Senegal	6,600	0	0	0	0	1	4	4	0	0	0	0	0	0
Sierra Leone	3,900	0	0	0	0	<1	1	1	0	0	0	0	0	0
Somalia	7,600	0	0	0	0	<1	2	2	0	0	0	0	0	0
South Africa	32,465	17	10	2,000	2,160	88	1,295	1,260	1,265	1,230	1,611	1,581	1,875	1,840
Sudan	21,500	2	0	12	0	5	45	50	4	4	9	10	0	0
Swaziland	650	0	1	0	180	7	2	2	181	180	0	0	181	180
Tanzania	21,733	2	2	60	65	5	45	55	25	35	25	35	25	35
Togo	3,000	0	0	0	0	2	2	2	0	0	0	0	0	0
Tunisia	7,352	5	1	30	25	27	90	90	30	30	30	30	20	20
Uganda	14,735	1	0	5	0	<1	5	5	0	0	2	2	0	0
Zaire	32,985	1	0	4	0	<1	10	11	2	2	2	3	0	0
Zambia	7,535	1	0	10	0	2	5	7	2	0	5	3	0	0
Zimbabwe	8,400	3	2	90	40	22	85	84	55	59	76	80	32	37
Africa	**560,676**	**96**	**34**	**3,123**	**3,112**	**13**	**3,256**	**3,281**	**2,019**	**2,096**	**2,387**	**2,402**	**2,431**	**2,472**
TOTAL WORLD	**4,829,457**	**4,091**	**1,161**	**235,681**	**168,627**	**92**	**202,596**	**214,366**	**147,747**	**155,820**	**203,379**	**215,611**	**148,601**	**155,855**

Moving to Central America, the picture is somewhat less bright. Many countries are still in a state of military and political uncertainty. However, for the region's largest producer, Mexico, a big improvement in the country's economic performance was seen in 1987. Paper and board output grew 4.3%, to over 2.5 million tons. Some restructuring is in progress within the paper industry, with Grupo Industrial Durango taking a lead. This company, which acquired the 100,000-tpy Atenquique pulp mill from the government last year, has also acquired the Centauro project, a large linerboard paper machine crated and awaiting construction since 1981. Durango, which last year also became the country's first supplier of market CTMP, plans to start the linerboard machine late next year.

AFRICA

Production of pulp and paper by the African countries was an estimated 2.4 million tons in 1987, the same level as the previous year. Pulp output also was approximately 2.4 million tons, practically unchanged from 1986.

Any appraisal of the continent's pulp and paper industry is dominated by the performance of South Africa, which accounts for roughly two-thirds of the continent's output of paper and board and about three-quarters of its pulp production. Unfortunately, South Africa's output and trade statistics are no longer published, but it is possible to make reasonable estimates based on a variety of freely available publications.

These show that 1987 was a relatively good year for the two major producers, Sappi and Mondi. Foreign trade in commodity pulp and paper grades was aided by a rise in international prices and by the twin fall of the U.S. dollar and the rand against other major currencies. On the domestic market, price hikes were possible for printing/writing and packaging papers, although buyers presented some stiff opposition.

1987 also brought its share of problems for South Africa's producers. A severe flood affected Mondi's Merebank newsprint mill, writing off thousands of tons of paper stocks and closing the mill for nearly a month. Sappi escaped the worst of the flooding but was hit by a chemical explosion that closed No. 2 pulp line at its Ngodwana market pulp and kraftliner mill. (Sabotage was ruled out by experts.) Full production was resumed within two months. But neither incident seriously affected the companies' trading performances.

Elsewhere in Africa, fortunes were varied. The high foreign debt of several nations, which must be serviced in hard currency, has led to a shortage of dollars to pay for market pulp and machine spare parts. In some cases, concurrent economic reform, involving price controls or the removal of import tariffs, made things worse for the domestic producers. The picture was brighter for the continent's market pulp producers. Both Morocco, with a capacity of 100,000 tpy of eucalyptus pulp, and Swaziland, which makes 180,000 tpy of unbleached softwood grades found their products in demand and were able to run at 100% capacity.

Few plans exist for capital expansion. In the case of South Africa, the full benefits of a wave of expansions completed at the start of the current economic boom are now being realized. Among the others, investment levels will remain small. One possible exception is Zimbabwe, where plans are slowly taking shape for a 60,000-tpy bleached kraft pulp mill and fine paper machine, as well as the possible expansion of mechanical pulping and newsprint capacity. 1988 is thus expected to be another static year. Apart from the inexorable growth in South Africa's trading performance, the other nations are likely to remain in the doldrums.

(By Peter Sutton, John Pearson, and Hugh O'Brian)

FAO OUTLOOK TO 1995

In its *Outlook for Pulp and Paper to 1995*, issued in 1987, the Food and Agriculture Organization of the United Nations estimated that worldwide production of paper and paperboard in 1984 accounted for 1% of total world economic activity—$100 billion, 187 million metric tons consumed. The industry was viewed as one that will continue to grow, at least into the mid-1990s, with demand rising to 246 to 255 million tons by 1995 and consumption increasing by 59 to 68 million tpy—an annual growth rate of 2.6% to 2.9%. Production capacity projected to 1995 will be adequate to meet demand, as will supplies of raw materials.

Per capita consumption of paper and paperboard was estimated at 55 lb (25 kg) in 1960, 84 (38) in 1984, and was forecast to reach 97 (44) in 1995.

Pulp consumption will increase from 140 million tons in 1984 to 177 to 181 million tons by 1995, according to the study. The ratio of pulp per ton of paper will decrease from 0.74 to 0.72 as wastepaper consumption rises from 49 million tons to 83 to 85 million tons by 1995. At that time, wastepaper will account for 32% of total fiber supply.

World trade in pulp and paper reached about $30 billion in 1984, 1.5% of total merchandise exports, and included 39 million tons of paper and board, 21 million tons of mechanical and chemical pulps, and four million tons of wastepaper. Countries in the developing economies accounted for $4 billion of this, or 1% of their total imports.

The world market is made up of some 150 importers. Of these, 75 have some production and 45 also export. Of the 75 countries relying on imports, 70 are developing countries. Most of the exports, 66%, are now supplied by five of the exporting countries. However, developing countries are increasing their production and sometimes becoming exporters, particularly of pulp. The trend is for developing countries to trade among themselves. The FAO expects these countries to increase their self-sufficiency. In 1954, developing countries imported 1.4 million tons and exported 50,000; in 1984 the figures were 6.6 million tons and 1.0 million, respectively. Product mix has also changed. Newsprint, for example, accounted for two-thirds of total volume in 1954, and by 1984 for only one-third.

Participants in the FAO study included an Advisory Committee of Experts on Pulp and Paper, an Industry Working Party (IWP), the FAO Secretariat and consultants. Results are frequently compared to the Chase Econometrics 1986 Long-Term Report. The paper/paperboard sector was divided into three large groups by grade.

Newsprint. World production was estimated at 29.2 million tons in 1984 and growth rates of 2.8% to 3.1% were projected to 1995, with consumption being 39.3 to 39.7 million tons at that time. The IWP estimated that world consumption of newsprint in 1995 would be lower, 36.4 million tons. Actual increases will depend on the development of electronic media, lower grammage weights, and the use developing countries make of newsprint—often for text, forms or other purposes.

Printing/writing paper. Consumption in this sector was projected to grow from 48.8 million tons in 1984 to 75.5 million tons by 1995, an average annual growth rate of 4.7%. The IWP, however, forecasted only 67.7 million tons, predicting an end to the rapid growth of special-interest magazines, and citing the flat outlook for directories, the expansion of television advertising and encroaching electronic communications. Office paper use will increase, but basis weights will go down as postal rates go up. Printing/writing papers will be used increasingly by developing countries and by centrally planned economies.

Other paper and paperboard. This sector accounted for 59% of total paper and paperboard consumption in 1984—109.2 million tons. A growth rate of 2.1% to 2.8% to 1995 was predicted, or 132.9 to 139.4 million tons. As with newsprint, the growth rate will be slower in developed countries than in other economies. The developing and planned economies may bypass some packaging stages the developed countries experienced, going directly to plastic or to metal containers.

TOTAL CONSUMPTION OF PAPER/BOARD, 1960-84

(million metric tons)

Year	Developed market economies	Developing market economies	Centrally planned economies	World total
1984	144	20	23	187
1980	129	18	22	169
1970	103	10	14	126
1960	61	4	8	73

Source: United Nations Food & Agriculture Organization's Outlook Study.

PROJECTED CONSUMPTION BY PAPER/BOARD CATEGORY TO 1995

(million metric tons)

	Actual	FAO		Chase	
Type of economy	1984	1990	1995	1990	1995
NEWSPRINT					
Developed market	22.9	25.7	29.3	25.8	28.9
Developing market	3.2	4.3	5.4	4.1	5.1
Centrally planned	3.0	4.0	5.0	4.2	5.1
Total	29.2	34.1	39.7	34.2	39.3
PRINTING/WRITING PAPER					
Developed market	39.5	46.5	57.1	46.3	55.5
Developing market	4.8	6.8	9.3	6.6	8.8
Centrally planned	4.5	6.7	9.0	7.0	9.2
Total	48.8	60.1	75.5	59.9	73.5
OTHER PAPER AND BOARD[1]					
Developed market	81.8	81.8	90.6	83.6	88.1
Developing market	12.0	16.7	22.2	15.7	20.6
Centrally planned	15.2	20.9	26.5	20.2	24.1
Total	109.2	121.6	139.4	119.7	132.9

1. This category accounts for paper and paperboard not in the other two categories and includes wrapping and packaging (such as containerboard, boxboard, and wrapping paper) and household and sanitary grades.

Source: United Nations Food & Agriculture Organization's Outlook Study.

PROJECTED PULP CONSUMPTION COMPARED WITH PREDICTED CAPACITY IN 1990

(million metric tons)

	Capacity 1990	Projected consumption 1990	
Product	FAO	FAO	Chase
Mechanical, incl. thermomechanical	39.3	30.7	30.8
Chemical, incl. semichemical	116.7	115.8	115.1
Other fiber	10.4	10.3	11.2
Total pulp for paper	166.4	156.9	157.2

Source: United Nations Food & Agriculture Organization's Outlook Study.

TOTAL WORLD PAPER/BOARD CONSUMPTION AND PRODUCTION PROJECTIONS TO 1995

(million metric tons).

FAO regions and subregions	Consumption					Production				
	Actual	FAO		Chase		Actual	FAO		Chase	
	1984	1990	1995	1990	1995	1984	1990	1995	1990	1995
Developed market economies	144.4	156.1	177.1	155.9	172.7	150.2	169.5	196.4	168.8	190.6
North America	73.4	76.1	82.6	78.3	84.6	76.5	83.5	93.2	87.7	97.0
West Europe	46.7	50.6	58.9	50.4	56.8	49.9	56.3	66.1	54.0	62.0
Oceania	2.5	2.8	3.2	2.9	3.3	2.2	2.4	2.9	2.3	2.6
Others	21.6	26.5	32.2	24.2	27.9	21.4	27.2	34.0	24.6	28.8
Developing market economies	20.1	27.9	37.0	26.5	34.7	15.3	17.2	22.1	16.5	21.3
Africa	0.8	1.1	1.4	1.1	1.3	0.3	0.4	0.5	0.4	0.5
Latin America	9.7	13.3	17.0	11.9	15.2	8.6	10.0	12.5	7.9	10.1
Near East Africa	0.4	0.7	0.9	0.6	0.7	0.1	0.1	0.1	0.1	0.2
Near East Asia	1.3	1.7	2.2	1.6	2.1	0.6	0.7	1.0	0.8	1.0
Far East	7.7	10.9	15.2	11.1	15.2	5.5	5.8	7.8	7.1	9.4
Centrally planned economies	22.8	31.8	40.6	31.5	38.5	22.0	29.1	36.2	28.6	33.8
Asia	7.5	12.1	16.2	14.5	20.0	7.0	10.5	13.7	12.3	16.2
Europe, U.S.S.R.	15.2	19.7	24.4	16.9	18.4	15.0	18.5	22.5	16.3	17.6
World	187.3	215.9	254.8	214.0	245.9	187.6	215.9	254.8	214.0	245.9

Source: United Nations Food & Agriculture Organization's Outlook Study.

GLOSSARY OF INDUSTRY TERMS

A

ABRASION RESISTANCE. Resistance to the rubbing or wearing away by friction of a paper surface—including the paper itself as well as any printing or coatings on it.

ABSORBENCY. The property of paper that causes it to take up liquid or vapors it contacts.

AIR DRIED. Artificial drying of paper by contact with air over skeleton dryers after paper has been surface-sized.

ALUM. Aluminum sulfate, used to hard-size paper for improved water resistance.

APPARENT DENSITY. The weight per unit volume of a sheet, usually obtained by dividing the paper's basis weight by its caliper (thickness).

B

BOD (biological oxygen demand). The amount of oxygen required for biological decomposition of waste in effluent (waste waters from the mill); an indirect measure of organic concentration in the effluent.

BASIS WEIGHT. The weight of a ream or other standardized measure of paper, expressed in pounds or in grams per square meter. By extension, the basis weight of one sheet of paper is the same as that of the standardized unit to which it belongs.

BASESTOCK. Paper that will be further processed, as in coating or laminating.

BEATER. A large mixing tub where pulp or wastepaper is mixed with various additives, such as fillers, dyes, and sizes. The action of the beater also serves to separate the pulp fibers.

BEATING. See *refining*.

BINDERS BOARD. A paperboard grade, used in construction of hard-back book covers.

BISULFITE PULP. Sulfite pulp.

BOGUS. (n.) Containerboard made from recycled waste materials. (adj.) Used to describe any paper or board made from inferior materials.

BOND PAPER. A type of uncoated free-sheet paper used for stationery and printing.

BONDING STRENGTH. Also called "internal bonding strength." (1) The degree to which the fibers within a sheet of paper adhere to each other. (2) The strength of the bond between the paper or board stock and its coating or other surface application. (3) The extent to which the plies of a board or laminated sheet are bonded together.

BOOK PAPER. Uncoated free-sheet paper used in books and commercial printing.

BRIGHTNESS. The light-reflecting property of paper, measured against a reference standard.

BRISTOL. A heavyweight paper grade, solid or laminated, with caliper thicknesses of 0.006 in. and up, characterized by extreme hardness, foldability, and strength.

BROKE. Trimmings, manufacturing waste, or damaged paper generated in a paper mill.

BULK. Term used to designate the thickness of a sheet of paper. A sheet with high bulk lacks compactness.

BURSTING STRENGTH (mullen). The tensile strength and extensibility of paper or paperboard, measured as the pressure required to rupture a specimen in a specified instrument (mullen) under specified conditions.

BUSINESS COMMUNICATION PAPERS. Papers for uses such as stationery, business forms, copier paper, checks, and commercial printing.

C

CALENDER. An assembly of rolls at the end of the paper machine imparting a final finish to the paper, increasing gloss and smoothness.

CALENDER-FINISHED. Any paper with a surface glazed by calenders, such as machine finish, English finish, supercalendered, and calender-friction glazed.

CALIPER. The thickness of a sheet measured under specified conditions. Caliper is usually expressed in thousandths of an inch (mils or points).

CARBONLESS COPY PAPER. A sheet capable of generating its own internal image, produced by pressure on its coated surface.

CARBONIZING PAPER. Lightweight basestock with proper finish on one or both sides, for later conversion into carbon paper.

CARLOAD. The minimum amount of paper required per freight car to qualify for shipment at the carload freight rate. This can be anywhere from 36,000 to 100,000 lb. Also refers to the amount of paper normally shipped in one freight car, since most shipments exceed the minimum carload requirement.

CASEMAKING MATERIALS. See *containerboard*.

CAST-COATED PAPER. Gloss paper. A paper or board whose coating is allowed to harden or set while in contact with a finished casting surface. Cast-coated papers generally have a high gloss.

CELLULOSE. The chief structural element and main chemical constituent of the cell walls of trees and other plants; it comprises from 40% to 50% of wood and more than 98% of cotton fiber. Chemically, cellulose is a polymer composed of glucose monomers.

CELLULOSE WADDING. One or several layers of lightweight creped tissue, loose or bonded together, used for cushioning in packaging.

CHEMICAL PULP. Pulp obtained by the cooking of wood in an aqueous solution of various chemicals. The principal chemical pulp processes are sulfite, sulfate (kraft), and soda.

CHEMI-THERMOMECHANICAL PULP (CTMP). Pulpmaking process in which woodchips are treated with chemicals prior to or during presteaming, followed by atmospheric refining.

CHIPBOARD. Paperboard made from wastepapers, of relatively low density, used where strength and quality are not required.

CLARIFIER. Large settling basin used to remove solid-waste material from mill effluent (wastewaters).

COATED PAPER. Paper with surface coating that produces smooth finish, on one or both sides.

COATING. The layer of mixed clays and adhesives, etc. (or a plastic solution without pigment or binder), that is applied to the surface of paper or paperboard to create a new surface.

COMBINATION BOARD. Any paperboard made on a cylinder machine in which the outer plies (either one or both) are made from a different stock or are a different color than the middle layer.

COMBINED BOARD. A paperboard made by joining two or more boards together with an adhesive.

CONSTRUCTION PAPER. Heavy groundwood paper grade, in various colors, used for elementary school artwork.

CONSTRUCTION PAPER/BOARD. Construction papers (principally roofing felts) and building boards (insulation board and hard-pressed board), later converted into building products; usually not included in "paperboard" data.

CONTAINERBOARD. Linerboard and corrugating medium used in manufacturing corrugated shipping containers.

COOKING. Treating raw materials with chemicals under pressure and extreme heat to produce pulp for papermaking. Also referred to as "pulping."

CORD. The amount of wood contained in a pile of logs measuring 4 ft x 4 ft x 8 ft (128 ft^3). Approximately 85 ft^3 of solid wood.

CORRUGATED BOARD. Corrugating medium which has been passed through a corrugator and is pasted to a flat sheet of linerboard (single-faced corrugated board) or is pasted between two sheets of linerboard (double-faced corrugated board). The pasted sheets are designated as "containerboard."

CORRUGATING MEDIUM. Paperboard used as the fluted (corrugated) material in corrugated shipping containers. Also termed "ninepoint," which is the caliper of the board (0.009 in.).

COVER PAPER. Range of paper grades used for covers of catalogs, brochures, and similar printed pieces.

CREPE PAPER. Paper given a crimped surface (by crowding it against a doctor blade during papermaking process), resulting in pliable, stretchable sheet.

CROSS DIRECTION. The direction at right angles to the machine direction in the plane of a sheet of paper.

CUNIT. 100 cubic feet of solid wood.

CURL. The tendency of paper by itself or in a laminate to bend or partly wrap around the axis of one of its directions.

CUT SIZE. Refers to business and writing papers that have been guillotined or rotary trimmed to dimensions of 8½ x11 and 8½ x14 in.; or any trimmed paper having dimensions of 16 x 21 in. or less.

CYLINDER MACHINE. A paper machine utilizing wire-covered cylinders or molds in which a web is formed from a dilute stock suspension.

D

DEINKING. The removal of ink, filler, and other extraneous materials from printed or unprinted reclaimed papers through a combination of mechanical disintegration and chemical treatment, followed by washing and, usually, bleaching. Flotation methods are also used to remove inks.

DIE CUT. The process by which paper or board is cut or stamped out to a specified shape or size with a steel die.

DIGESTER. Large reactor vessel in which wood is cooked in an aqueous solution to form chemical pulp.

DIMENSIONAL STABILITY. The property of a sheet of paper that relates to the constancy of its dimensions.

DUPLEX. Any paper or paperboard that has a different color, texture, or finish on either side. Also, a general term applied to any multi-ply paper or board.

DRY END. The drying section of the paper machine in which the paper is dried and from which finished paper is wound onto a reel.

DRYERS. Steam-heated, hollow metal cylinders that dry the wet paper web as it passes around them in the paper machine.

E

ELECTROSTATIC PRINTING. A method of printing in which the ink is affixed to the web by electrostatic methods.

ELMENDORF TEST (tear). A standard test for determining the tearing strength of paper. See also *tear*.

ELONGATION (stretch). Describes the "give" of a sheet of paper under tension, usually determined by means of a tensile tester.

EMBOSSED. A term applied to paper on which a raised or depressed design is pressed, die-stamped, or printed.

ENAMEL. Any glossy, shiny-surfaced, coated paper; also refers to a coating material on a paper.

ENCAPSULATED INK. Ink encapsulated with a coating giving a free-flowing dry system that can be activated by heat or pressure. Used for carbonless paper.

ENGLISH FINISH. Book paper with a finish more smooth than machine-finish and less smooth than supercalendered.

F

FABRIC. A fine-mesh woven screen on a paper machine on which paper is formed from a pulp slurry as water drains away.

FANFOLD. Continuous multiple-ply form manufactured from a single wide web that is folded longitudinally so as to form a flat pack, as differentiated from roll form. Also called "zig-zag fold" or "flat pack."

FELT. A continuous belt made of wool or various combinations of wool, cotton, asbestos, and/or synthetic fibers. Felts move the sheet through the paper machine, serving as a cushion and a medium for water removal.

FELT SIDE. The side of the paper web that has not been in contact with the wire during manufacture; the top side of the sheet.

FIBER. The threadlike units of vegetable growth that supply the structural basis of paper; also, synthetic filaments used in paper or other sheet materials ("synthetic fiber"). See also *secondary fiber*.

FILLER. (1) A mineral pigment added to the fiber furnish to improve the opacity, color, or printing qualities of paper. (2) In paperboard, the inner ply or plies as distinguished from the liners (outside plies).

FINE PAPER. A broad term for paper grades generally used for writing and printing, including bond, ledger, cover, and book papers; as distinguished from wrapping and other coarse papers.

FINISH. (n.) The surface property of a paper sheet determined by its surface contour and gloss (antique, eggshell, vellum, machine, English, supercalendered, plate, etc.). (v.) To "finish" paper or paperboard is to cut, trim, sort, and/or pack the paper, in finishing department of paper mill.

FLEXOGRAPHIC PRINTING. Formerly called "aniline printing." A method of rotary letterpress printing that employs flexible plates and rapid-drying inks.

FLUFF PULP. Pulp, normally paper-grade kraft pulp, sold in rolls for fluffing. Fluff pulp is used as absorbent material in sanitary and health products.

FLUORESCENT PAPER. A paper coated with a fluorescent pigment that not only reflects a visible wavelength, but is activated by most of the remaining absorbed light to re-emit it as color of a longer wavelength, which results in reinforcement of the reflected color.

FORMATION. A property of paper that is determined by the degree of uniformity of distribution of the solid components of the sheet with special reference to the fibers.

FORMS BOND. See *register bond*.

FOURDRINIER. A paper machine utilizing a horizontal, moving, fine-mesh screen on which paper is formed from a very dilute slurry of pulp and water.

FREE-SHEET. "Woodfree" paper containing 10% or less groundwood (mechanical) pulp.

FREENESS. The quality of pulp stock that determines the rate at which water drains from the stock suspension as it is being formed into a sheet on a wire mesh screen or perforated plate; usually measured on a Canadian Standard freeness tester, which has a perforated metal plate.

FURNISH. (n.) The mixture of various materials (pulp, sizes, wet-strength, or other additives, fillers, and/or dyes) that are blended in the stock suspension from which paper or paperboard is made.

G

GLASSINE PAPER. Translucent, smooth, grease-resistant paper made by extensive beating and subsequent supercalendering; made from primarily chemical pulps.

GLOSS. Light-reflective properties of a paper surface.

GRAIN. The direction in which the majority of fibers lie in the paper sheet, corresponding with the direction in which the paper is made on the machine ("machine direction").

GRAVURE PRINTING. An intaglio printing process employing minute engraved "wells." In general principle, deeply etched wells carry more ink than a raised surface, hence print darker values. Shallow wells are used to print light values. A doctor blade wipes the excess ink from the cylindrical printing surface. Rotogravure employs etched cylinders and web-fed stock. Sheet-fed gravure, as its name implies, involves individual sheet feeding.

GROUNDWOOD PULP. Pulp made by grinding wood with abrasive equipment (grinding stones) in the presence of water.

GROUNDWOOD PAPER. Paper containing a high percentage (over 10%) of groundwood pulp.

H

HAND. (feel). A term used to express the impression obtained by handling paper to judge its finish, flexibility, and general quality.

HARD-SIZED. Any paper that has been treated with a large amount of size to make it highly water-resistant.

HARDWOOD. Wood from deciduous (broad-leaved) trees, having short fibers.

HEMICELLULOSE. A polysaccharide polymer associated with cellulose and also lignin in plant fibers; comprises between 20% and 30% of the chemical composition of wood.

HOLDOUT. The degree to which a sheet resists penetration by liquids, such as water or ink.

HOTMELTS. Molten plastics or waxes applied as a coating to paper or paperboard, forming an attractive, high-gloss surface with good flexible barrier properties (resistance to liquids and gases).

I-K

INDUSTRIAL PAPERS. Broad term covering papers manufactured for industrial uses, such as packaging, tissue, and wrapping papers.

INTEGRATED MILL. A paper mill that produces all or almost all of the pulp it uses in papermaking.

INTERNAL BONDING STRENGTH. See *bonding strength.*

JOB LOT. Out-of-specification paper that is sold at less than full price.

JUMBO ROLL. Industry term for large roll of paper.

KRAFT PAPER. Paper of high strength ("kraft" means strength in German), unbleached or bleached, produced from kraft (sulfate) pulp.

KRAFT PULP (Sulfate pulp). The strongest chemical pulp, made by the alkaline process of cooking wood in a solution of sodium hydroxide and sodium sulfide.

L

LACQUER. A solution or suspension of one or more materials in volatile solvents capable of forming a protective and/or decorative film, or a film with special surface properties, after the solvents have evaporated.

LAMINATED PAPER. Paper that is developed by fusing one or more layers of paper or paperboard together to the desired thickness and quality, or when other substances such as thin sheets of metal, plastic, cellophane, cloth, etc., are fused to paper.

LEDGER PAPER. A business-paper grade, a strong sheet, used for accounting and records.

LETTERPRESS PRINTING. A printing process in which the ink is applied to paper, paperboard, or films from raised portions of printing plates or type.

LIGNIN. A complex, noncarbohydrate substance that, along with cellulose, forms and binds together the cell walls of plants; comprises between 20% and 40% of wood by weight.

LINERBOARD. Paperboard used as the outer, facing material in corrugated board used for shipping containers.

M

MICR (magnetic ink character recognition) PAPER. Writing papers that can be printed with magnetic ink, as used in data processing machines.

MACHINE-COATED. Paper that is coated, on one or both sides, on the paper machine.

MACHINE DIRECTION. Grain. The direction of the paper parallel to its forward movement on the paper machine.

MACHINE-FINISH (MF). (1) Any finish on a paper machine. It may be that of the sheet as it leaves the last dryer or as it leaves the calender stack, and it may be either a dry or wet finish. (2) When used with the name of a grade or type of paper, denotes a machine finish of less than the maximum range of smoothness.

MACHINE-GLAZED (MG) PAPER. Paper with a high, glossy finish on one side of the sheet only, made on a yankee machine and used for wrapping and poster work.

MANIFOLD. A lightweight, dense paper, usually in basis weights of 7 to 9 lb, with unglazed or machine-glazed finish, used primarily for carbon copies of typewritten material.

MATTE FINISH. A dull finish with little or no gloss.

MECHANICAL PULP. Pulp produced by mechanical rather than chemical processes; includes stone groundwood, refiner groundwood, thermomechanical, defibrated, and exploded pulp. See chapter on pulping processes.

MEDIUM. See *corrugating medium.*

MOISTURE CONTENT. Percent of moisture. The moisture present in a material, as determined by specified methods.

MOISTUREPROOF. The property of a material that makes it substantially impervious to water vapor.

MOISTURE VAPOR TRANSMISSION. The rate at which water vapor permeates a paper.

MOTTLE. Nonuniform coloring of a sheet of paper, whether intentional or accidental.

MULLEN. See *bursting strength.*

MULTI-PLY. Consisting of two or more plies, or layers.

N-O

NEWSPRINT. A generic term used to describe paper of the type used for printing newspapers.

NINEPOINT. See *corrugating medium.*

NONWOVEN FABRIC. A clothlike material made of fibers longer than those normally used in papermaking; instead of being woven on a loom, the fibers are matted together by means of several different processes, including formation on paper machines.

OCR (optical character recognition). An information processing technology dealing with the conversion of imprinted or written data to another language and medium.

OFF-MACHINE COATED PAPER. Paper that is coated, on one or both sides, after it has been removed from the paper machine.

OFFSET PRINTING. A process of indirect printing in which an impression of type or a design on a flat plate is printed on a rubber-blanketed cylinder from which it is impressed ("off-set") upon the surface to be printed.

ONIONSKIN. Lightweight paper, basis weight 7 to 9 lb, often with cockle finish, used primarily for copies in office correspondence.

OPACITY. The property of a sheet of paper that obstructs the passage of light and prevents print or any object on or in contact with the other side from being seen through the sheet; the opposite of "showthrough."

P

PAPER. A web or sheet of fibers (primarily cellulose), formed on a fine wire or fabric from a water suspension.

PAPER STOCK. Wastepaper which is reused in manufacture of paper and paperboard, generally after it has been sorted into various recognized grades.

PAPETERIE. Woodfree paper used for stationery, greeting cards, etc.

PATENT COATED. Denotes a cylinder grade of boxboard that has been vat-lined on one or both sides with a white stock to improve the surface.

PICK. Refers to the tendency of fibers or particles of a sheet of paper to be pulled away from the sheet surface by tacky surfaces such as printing plates.

PIGMENT. A mineral or organic additive used to color paper or coating, or to develop opacity.

PLY. A web or layer of paper or paperboard.

POINT. Caliper measurement of a sheet of paper, in thousandths of an inch (0.001 in.).

POROSITY. The degree to which a paper contains connected air pockets. Porosity affects the absorbency of a paper, and is measured by determining the rate of air flow through a given sheet of paper in a densometer.

PRESSURE-SENSITIVE PAPER. Paper coated on one or both sides with adhesive, which is activated by pressure. Usually used in the manufacture of labels and tapes.

PRINTABILITY. Refers to paper properties that determine the quality of appearance of the sheet after printing, as judged by uniformity of color of the printed areas, uniformity of ink transfer, contrast, legibility, and so forth. Printability is determined by the paper's ink receptivity, uniformity, compressibility, smoothness, opacity, color, and resistance to picking.

PULP. Primary raw material from which paper is made; a fibrous product produced by mechanical or chemical processes (or a combination). See chapter on pulping processes.

R

RAG CONTENT. Also called "cotton-fiber content;" indicates that a percentage of a sheet of paper is made up of cotton fiber. For a paper to qualify as "rag-content paper," it must contain a minimum of 25% cotton fiber, and may be high as 100% cotton or "rag."

REAM. A quantity of sheets of paper, usually 500 sheets (in rare cases, 480 sheets).

REFINER MECHANICAL PULP (RMP). Pulpmaking process in which woodchips are refined under atmospheric conditions without pretreatment.

REFINING. The mechanical treatment of pulp in a water suspension to convert the fiber into a form suitable for papermaking.

REGISTER. The exact, corresponding placement of successively printed images.

REGISTER BOND. A lightweight bond paper used primarily for business forms and computer printouts.

RELATIVE HUMIDITY. The ratio of the amount of moisture in the air at any temperature to the amount required at that temperature to saturate the air.

RELEASE PAPER. A group of papers specifically designed for easy stripping from or nonadherence to tacky surfaces.

ROSIN. The residue obtained after distilling off the volatile matter (turpentine) from the gum of southern pine, commonly used for internal (beater) sizing.

ROTOGRAVURE PRINTING. See *gravure printing*.

RUNABILITY. The efficiency with which a paper can be printed and handled in the press, and the paper's ability to withstand the stresses of the printing process unaltered.

S

SCREENINGS. Knots of pulp and other materials too coarse to pass through pulp or stock screens, separated or screened from the stock before it contacts the paper machine wire. Screenings are often used to make coarse papers or paperboards.

SECONDARY FIBER. Fiber that has been previously used for papermaking, including stock reclaimed from post-consumer wastepaper and converting plant waste as well as "broke" (See *broke*).

SEMICHEMICAL. Pulp made by a combination of mechanical and chemical processes and usually used for corrugating medium.

SHEET. (1) A single leaf of paper as distinct from a roll. (2) Any paper not in roll form. (3) Paper, in general.

SILK SCREEN PRINTING. A method of printing in which the ink is forced through a design on a taut silk screen, made of bolting cloth, onto the object to be printed.

SILVICHEMICALS. Chemicals derived from wood, including byproduct chemicals from pulping processes.

SIZE. Any substance used in or on paper to make it water- or ink-resistant, such as rosin, glue, gelatin, starch, latex, and synthetic resins.

SIZE PRESS. The section near the end of the paper machine where paper is surface-treated with starch or other sizing solutions.

SLURRY. A suspension in water or adhesive solution of pigments or other insoluble materials used in coating or papermaking.

SLUSH. A highly watery suspension of paper pulp that flows easily and can be pumped.

SODA PULP. Chemical pulp made principally from hardwoods by cooking the wood in a solution of caustic soda. Generally used in combination with bleached sulfite or kraft pulp for the manufacture of book and printing papers.

SOFTWOOD. Wood from coniferous (needled) trees, having long fibers.

SOLID BOARD. A general term indicating that the board is made of the same material throughout, as contrasted with a combination board in which two or more stocks are used.

SPENT LIQUOR. Cooking liquor that has been used in the manufacture of chemical pulp and that contains lignin, resins, and other substances extracted from wood.

SPLICE. The joining of the ends of two webs of paper to make a continuous roll.

STANDARD CONDITION. Standard conditions for paper testing, normally specified as 73°F ±2° and 50% ±3% relative humidity.

STARCH. The chief sizing agent used for paper.

STIFFNESS. The ability of paper or paperboard to resist deformation under stress.

STOCK. (1) Furnish. (2) Wet pulp of any type at any stage of the manufacturing process.

STRIKETHROUGH. Penetration of ink through a sheet of paper so that it shows through on the unprinted side.

SULFATE PULP. See *kraft pulp*.

SULFITE PULP. Chemical pulp made by the acid process of cooking wood in a solution of sulfurous acid and a bisulfite salt. Bisulfite pulp.

SUPERCALENDER. Off-machine calender rolls that heat and iron paper to produce a high-gloss finish.

SURFACE-COATED. Term applied to paper or paperboard that has one or both sides coated with a pigment or other coating material.

SURFACE COLORING. The application of color to paper after the web has been formed on the paper machine; may be done on-machine at the calender rolls or off-machine as a separate operation.

SURFACE-SIZED. Any paper to which size has been applied when the sheet is dry or partially dry, at the size press or in a separate operation.

SYNTHETIC FIBER. Any manmade fiber, including those derived from cellulose, such as rayon and acetate, as well as the purely manmade, such as nylon and acrylic fiber.

T

TACK. The stickiness or pulling power of ink or adhesives.

TALL OIL. A byproduct of chemical pulping derived from spent liquors, containing principally rosin and fatty acids, with some sterols, alcohols, and other materials; used in soaps, lubricants, greases, rubber, paints, chemicals.

TARNISHPROOF PAPER. Refers to a paper being free of substances that will discolor or blemish copper or silver.

TEAR. The resistance of a sheet of paper to tearing; measured with an Elmendorf tear tester as the force in grams necessary to tear a strip of paper.

TENSILE STRENGTH. The force, parallel to the plane of the specimen, required to break a given width and length of paper under specified conditions.

TEST LINER. Bogus or recycled linerboard.

TEXT PAPER. High-quality printing papers.

THERMOMECHANICAL PULP (TMP). Pulpmaking process using presteaming and pressurized refining of untreated (no chemical treatment) woodchips.

TRANSPARENCY. Property of a material that transmits light rays so that objects can be distinctly seen through the specimen.

TRIM. The width of the sheet of paper at the [illegible] end of a paper machine.

TWIN-WIRE MACHINE. A paper machine using two forming wires. Sections of the two wires are close to each other and parallel. A pulp slurry is injected between the two wires and water is removed from both sides of the sheet of paper as it is formed.

TWO-SIDEDNESS. Refers to the subtle yet definite difference in shade or texture between the felt and wire sides of a sheet of paper.

V-W

VEGETABLE PARCHMENT. A grease- and water-resistent paper resembling animal parchment made by passing unsized paper through sulfuric acid in order to gelatinize its surface, followed by washing and drying.

VELLUM FINISH. Toothy surface, relatively absorbent for fast ink penetration, usually applied to text papers.

WASTEPAPER. Pre-consumer waste (mostly trim and clippings from converting plants) and post-consumer waste (used newspapers, old corrugated containers, office waste, etc.) used in manufacture of paper and paperboard.

WEB. The continuous sheet of paper coming from the paper machine in its full width or from a roll of paper in any converting operation.

WET END. The front section of the paper machine where the pulp slurry is introduced for formation into paper.

WET MACHINE. A one-cylinder machine used to form pulp into thick, rough sheets sufficiently dry to permit folding into laps (bundles); also used to make certain types of heavy boards, the thick wet sheets being dried flat in specially constructed dryers.

WET STRENGTH. The tensile strength of a sheet of paper when completely wet; sometimes calculated as a percentage of its dry strength.

WET-STRENGTH PAPER. Paper with an extremely high resistance to tearing or disintegration when completely wet. To qualify as wet-strength paper, a sheet must retain over 15% of its dry tensile strength when saturated with water.

WHITE PAPERS. See *business communication papers.*

WIRE. A fine-mesh metal wire or plastic screen on the paper machine on which paper is formed from a pulp slurry as water drains away.

WIRE MARK. The impression of the machine wire or dandy roll of the paper machine in the paper.

WIRE SIDE. The side of a sheet of paper that has had contact with the wire of the paper machine during manufacture. Paper from a twin-wire machine has two wire sides.

WOODFREE. Pulp: chemical pulp. Paper: Paper grades made from chemical pulp.

Y

YANKEE MACHINE. A type of fourdrinier or cylinder machine having a single drying cylinder with a highly polished surface, used for making machine-glazed paper or for drying tissue.

METRIC CONVERSION GUIDE

Pertinent conversion tables reproduced from *Metrication for the Pulp and Paper Industry* by Kenneth E. Lowe (Miller Freeman Publications, 1975).

CONVERSION LIST FOR NORTH AMERICAN AND METRIC UNITS

To convert	Into	Multiply by
acre	hectare	0.4047
Btu (mean)	joule	1.05587×10^3
centimeter	foot	0.03281
	inch	0.3937
cord	(see Forestry Terms)	
foot	centimeter	30.48
	meter	0.3048
gallon (U.S. liquid)	gallon (U.K.)	0.8327
	liter	3.785
gallon (U.K.)	gallon (U.S. liquid)	1.20094
	liter	4.545
horsepower (electric)	kilowatt	0.746
horsepower-hour	kilowatt-hour	0.746
inch	centimeter	2.54
	meter	0.0254
joule	Btu	9.4845×10^{-4}
	calorie (mean)	0.23866
kilogram-mass	pound (avdp)	2.2046
	ton (metric)	0.001
	ton (short)	1.102×10^{-3}
kilometer	foot	3281
	mile (statute)	0.6214
kilowatt	horsepower (electric)	1.34
kilowatt-hour	horsepower-hour	1.34
liter	gallon (U.K.)	0.21998
	gallon (U.S. liquid)	0.2642
meter	foot	3.281
ounce (avdp)	gram	28.3495
	pound (avdp)	0.0625
pound (avdp)	kilogram	0.4536
pound/inch² (psi)	kilogram-force/cm²	0.07031
square foot	square centimeter (cm²)	929.0
	square meter (m²)	0.09290
square meter	square foot (ft²)	10.76
	square inch (in.²)	1550
ton (long)	ton (metric)	1.016
	ton (short)	1.120
ton (metric)	ton (long)	0.9842
	ton (short)	1.1023
ton (short)	ton (long)	0.89286
	ton (metric)	0.90718
yard	centimeter	9.144
	meter	0.9144

FACTORS FOR CONVERTING REAM AND BASIS WEIGHTS TO GRAMMAGE

Paper grade	Trade size 500-sheet ream (in.)	Grammage (g/m²) to ream or basis weight[1]	Ream weight[2] to grammage
Writing and printing	17 x 22	0.266	3.760
Demy size	17 1/2 x 22 1/2	0.280	3.571
Blotting	19 x 24	0.324	3.083
Cover	20 x 26	0.370	2.704
Tissue (double-crown size)	20 x 30	0.427	2.343
Cardboard	22 x 28	0.438	2.282
Bristol and tag	22 1/2 x 28 1/2	0.456	2.195
News and wrapping (3000 ft²)	24 x 36	0.614	1.627
Book	25 x 38	0.675	1.480
Former standard size	25 x 40	0.711	1.406
Paperboard	1000 ft²	0.205	4.881

Note: If the conversion factor for a sheet size is not listed, the ream weight or grammage can be calculated by the following formulas:

Converting ream weight (lb/500 sheets) to grammage:

$$\text{g/m}^2 = \frac{\text{ream weight x } 1406}{\text{sheet area in square inches}}$$

Converting grammage to ream weight in lb/500 sheets:

$$\text{lb/ream} = \text{g/m}^2 \text{ x sheet area in square inches x } 0.000711$$

[1] If the given trade size is in 480 sheets, then factor should be multiplied by 48/50 (or 0.960).

[2] If the given trade size is 480 sheets, then factor should be multiplied by 1.042.

Source: Based on TAPPI Standard T410.

COMPARISON OF ISO AND NORTH AMERICAN PAPER SIZES

ISO SIZES			NORTH AMERICAN SIZES		
	Millimeters	Inches		Millimeters	Inches
A0	841 x 1189	33 1/8 x 46 3/4	NA0	889 x 1143	35 x 45
A1	594 x 841	23 3/8 x 33 1/8	NA1	559 x 864	22 x 34
A2	420 x 594	16 1/2 x 23 3/8	NA2	432 x 559	17 x 22
A3	297 x 420	11 2/3 x 16 1/2	NA3	279 x 432	11 x 17
A4	210 x 297	8 1/4 x 11 3/4	NA4	216 x 279	8 1/2 x 11
A5	148 x 210	5 7/8 x 8 1/4	NA5	139 x 216	5 1/2 x 8 1/2
A6	105 x 148	4 1/8 x 5 7/8	NA6	108 x 139	4 1/4 x 5 1/2

METRIC UNITS FOR WIDELY USED TERMS IN FORESTRY

Term	North American symbol or definition	Suggested metric unit	Equivalent
		LAND AREA	
Acre		hectare (ha)	1 acre = 0.4047 ha
Square mile	640 acres	hectare (ha)	1 mi^2 = 259.0 ha
		square kilometer (km^2)	1 mi^2 = 2.59 km^2
Section	640 acres	hectare (ha)	1 section = 2.59 km
Township	36 square miles (mi^2)	hectare (ha)	1 township = 9324 ha
		LUMBER AND BOARD MEASUREMENTS	
Board foot	bdf	cubic meter (m^3)	1 bdf = 0.002360 m^3
1000 board feet	1000 bdf	cubic meter (m^3)	1000 bdf = 2.360 m^3
Cubic foot	ft^3	cubic meter (m^3)	1 ft^3 = 0.02832 m^3
Square foot	ft^2	square meter (m^2)	1 ft^2 = 0.09290 m^2
Thickness	in.	millimeter (mm)	1 in. = 25.4 mm
		WOOD AND PULPWOOD MEASUREMENTS	
Cord	128 ft^3	cubic meter (m^3)	1 cord = 3.624 m^3
Unit	160 ft^3 (wood)	cubic meter (m^3)	1 unit (160 ft^3) = 4.528 m^3
	200 ft^3 (chip)	cubic meter (m^3)	1 unit (200 ft^3) = 5.664 m^3
Cunit	100 ft^3 (solid)	cubic meter (m^3)	1 cunit = 2.832 m^3
Cubic foot	ft^3	cubic meter (m^3)	1 ft^3 = 0.02832 m^3
Yield/acre	ft^3/acre	cubic meter/hectare (m^3/ha)	1 ft^3/acre = 0.06998 m^3/ha

CONVERSIONS FOR ACCOUNTING (continued next page)

Unit cost	Multiply by	To obtain
AREA		
\$/acre	2.47105	\$/hectare
\$/square foot	10.7639	\$/square meter
\$/1000 square feet	0.0107639	\$/square meter
	10.7639	\$/1000 square meters
\$/3000 square feet	0.0035879	\$/square meter
ELECTRICAL		
\$/kilowatt-hour	1.0	\$/kilowatt-hour
	0.277778	\$/megajoule
ENERGY		
\$/cubic foot (gas)	35.3147	\$/cubic meter
\$/1000 cubic foot (gas)	35.3147	\$/1000 cubic meters
\$/gallon (U.S.)	(see *Volume*)	
\$/gallon (U.K. liquid)	(see *Volume*)	
FREIGHT		
\$/ton (2000 lb)	(see *Weight*)	\$/metric ton
\$/ton-mile	0.6849	\$/metric ton-kilometer
LABOR		
ton (2000 lb)/man-day	0.9072	metric ton/man-day
\$/ton (2000 lb)	1.10231	\$/metric ton

CONVERSIONS FOR ACCOUNTING (continued)

Unit cost	Multiply by	To obtain
VOLUME		
$/gallon (U.S.)	0.264173	$/liter
	264.173	$/cubic meter
$/gallon (U.K.)	0.219969	$/liter
	219.969	$/cubic meter
$/1000 gallons (U.S.)	0.264173	$/1000 liters
	0.264173	$/cubic meter
$/million gallons (U.S.)	0.264173	$/1000 cubic meters
$/cubic foot	35.3147	$/cubic meter
$/cubic yard	1.30795	$/cubic meter
WEIGHT (MASS)		
$/pound	2.20462	$/kilogram
$/100 pound (cwt)	0.0220462	$/kilogram
$/short ton (2000 lb)	1.10231 (0.9072)	$/metric ton
$/long ton (2240 lb)	0.984206	$/metric ton
WOOD VOLUME		
$/board foot	423.76	$/cubic meter
$/1000 board feet	0.42376	$/cubic meter
$/cubic foot	35.3147	$/cubic meter
$/cord (128 ft^3)	0.2759	$/cubic meter
$/unit (wood)	0.2208	$/cubic meter
$/unit (chip)	0.1766	$/cubic meter
$/cunit (100 ft^3)	0.3531	$/cubic meter

For example, assume the selling price for 42-lb linerboard is $300/ton. Calculate the price per 1000 m^2:

300 x 42.0 = $6.30/1000 ft^2; thus 2000

6.30 x 10.764 = $67.81/1000 m^2

Another formula for calculating price on a 1000-m^2 basis is:

$/1000 m^2 = ($/metric ton) (grammage) (0.001)

For example, assume that the selling price of linerboard with a grammage of 205 g/m^2 is $400/metric ton. Calculate the price per 1000 m^2:

400 x 205 x 0.001 = $82.00/1000 m^2

SOURCES OF INDUSTRY INFORMATION

This section is a listing of publications about the pulp and paper industry, with emphasis on economics and marketing aspects and excluding manufacturing technology. Periodicals, books, and special studies are listed alphabetically by title, with frequency of publication (or date of issue), and name and address of publisher or distributor.

Special reports and surveys (generally priced at $1,000 or higher) are listed in a second section.

Firms providing special market reports are listed in the final section.

American Papermaker (in four regional editions; monthly except bimonthly in October)
Allen/Abernethy Publishing Div. of ASM Communications Inc.
75 Third St. N.W., Atlanta, Ga. 30365

Annual Review of Pulp and Paper Mill Projects Worldwide (annual)
Jaakko Pöyry Oy
Box 16, SF-00441 Helsinki, Finland

Annual Survey of U.S. Businesses' Plans for New Plants and Equipment (McGraw-Hill Capital Spending Surveys)
Data Resources
24 Hartwell Avenue, Lexington, Mass. 02173

Boxboard Containers (monthly)
Maclean-Hunter Publishing Corp.
300 W. Adams St., Chicago, Ill. 60606

Business Papers Market (covering 1985 symposium)
Edited by PULP & PAPER
Miller Freeman Publications
500 Howard St., San Francisco, Calif. 94105

Canada: Exports by Commodities and Countries (Catalog 65-004—includes pulp and paper grades; monthly)
Statistics Canada
Publications Distribution, User Services Div.
Ottawa, Ont. K1A 0T6, Canada

Canada: Imports by Commodities and Countries (Catalog 65-007—includes pulp and paper grades; monthly)
Statistics Canada
Publications Distribution, User Services Div.
Ottawa, Ont. K1A 0T6, Canada

Canadian Market Pulp Statistics (monthly)
Canadian Pulp & Paper Assn.
2300 Sun Life Bldg., 1155 Metcalfe St.
Montreal, Que. H3B 2X9, Canada

Canadian Paper Analyst (monthly)
Box 300, Victoria Station
Westmount, Que. H3Z 2V5, Canada

Canadian Pulp and Paper Capacity (annual)
Canadian Pulp & Paper Assn.
2300 Sun Life Bldg., 1155 Metcalfe St.
Montreal, Que. H3B 2X9, Canada

Capital Investment Service (update on order)
Prepared by PULP & PAPER INTERNATIONAL
Chaussée de Charleroi, 123a, Bte 5
B-1060 Brussels, Belgium

Capital Spending
(see Mill-by-Mill Listings)

Carbonless Copy Paper, 1980 through 1990
(5th edition)
Laves Chemie
Hamburger Allee 12, D-6000 Frankfurt 90,
Fed. Rep. Germany

1982 Census of Manufactures
Pulp Mills (SIC 2611)
Paper Mills, except Building Paper (SIC 2621)
Paperboard Mills (SIC 2631)
Building Paper & Board Mills (SIC 2661)
other SIC 26 reports available
U.S. Dept. of Commerce, Bureau of Census
Subscriber Services (Publications)
Washington, D.C. 20233

1982 Census of Manufactures, Vol. 2, Industry Statistics, Part 1, SIC major groups 20-26
Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402

Competitive Grade Finder for the Paper and Graphic Arts Industry (annual)
Grade Finders Inc.
Box 944, Exton, Pa. 19341

The Corrugated and Paperboard Container Industry: An Analysis of Current Markets and Prospects for Future Growth (1986)
Business Trend Analysts
2171 Jericho Turnpike, Commack, N.Y. 11725

Cost Effective Product Development & Marketing in Paper & Board Mills (1986)
Euro-Data Analysts
Box 13, Dorking, Surrey RH5 4YL, U.K.

Current Industrial Reports: Pulp, Paper & Board—M26A (annual)
U.S. Dept of Commerce, Bureau of the Census
Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402

Dictionary of Paper (4th edition, 1980)
American Paper Institute
260 Madison Ave., New York, N.Y. 10016

Estimated Production of Pulp, Paper and Paperboard in Certain Countries (annual)
Food & Agriculture Organization, United Nations
Via della Terme di Caracalla, I- 00100 Rome, Italy

Exports of Kraft Linerboard and Corrugating Material (annual)
American Paper Institute
260 Madison Ave., New York, N.Y. 10016

Fibre Box Industry Annual Report
Fibre Box Assn.
5725 N. East River Road, Chicago, Ill. 60631

Fibre Market News (two times a week)
Market News Publishing Corp.
156 Fifth Ave., New York, N.Y. 10010

Fiber Statistics Subscription Service
American Paper Institute
260 Madison Ave., New York, N.Y. 10016

Finnish Forest Industries, 1987
Central Assn. of Finnish Forest Industries
Eteläesplanadi 2, SF-00130 Helsinki, Finland

Forecaster (bimonthly)
Miller Freeman Publications
500 Howard St., San Francisco, Calif. 94105

Forest Products and Paper Industry (monthly)
Merrill Lynch, Pierce, Fenner & Smith Inc.
Securities Research Div.
165 Broadway, New York, N.Y. 10080

Future Prospects of the Soviet Pulp and Paper Industry
Indufor Ky
Kapteeninkatu 14, Box 121, SF-00141, Helsinki, Finland

Hay-Roe's PaperTree Letter (monthly)
PaperTree Economics Ltd.
201-744 West Hastings St.
Vancouver, B.C. V6C 1A5, Canada

International Directory of the Nonwoven Fabrics Industry (biennial)
Assn. of Nonwoven Fabrics Industry
1700 Broadway, New York, N.Y. 10019

International Glossary of Technical Terms for the Pulp and Paper Industry (1976)
Edited by PULP & PAPER INTERNATIONAL
Miller Freeman Publications
500 Howard St., San Francisco, Calif. 94105

International Report (intermittent)
American Paper Institute
260 Madison Ave., New York, N.Y. 10016

International Trade Report (monthly)
National Forest Products Assn.
1250 Connecticut Ave. N.W., Suite 200
Washington, D.C. 20036

Kraftliner Price Movements vs Supply & Demand Shifts Since 1974
Data-Transcripts
Box 14, Dorking, Surrey RH5 4YN, U.K.

Lockwood-Post's Directory of the Pulp and Paper and Allied Trades (annual)
Miller Freeman Publications
500 Howard St., San Francisco, Calif. 94105

Map of the European Pulp & Paper Industry (1984)
Miller Freeman Publications
500 Howard St., San Francisco, Calif. 94105

Market Pulp 5 (Proceedings of PULP & PAPER INTERNATIONAL's 5th International Pulp Symposium, 1987)
Miller Freeman Publications
500 Howard St., San Francisco, Calif. 94105

Market Pulp Survey
Edited by PULP & PAPER INTERNATIONAL
Miller Freeman Publications
500 Howard St., San Francisco, Calif. 94105

Mill-by-Mill Listings of Capital Spending Programs (semiannual)
Prepared by PULP & PAPER Project Report
Miller Freeman Publications
500 Howard St., San Francisco, Calif. 94105

Monthly Newsprint Statistics
Canadian Pulp & Paper Assn.
2300 Sun Life Bldg., 1155 Metcalfe St.
Montreal, Que. H3B 2X9, Canada

Monthly Report on Pulp and Paper Mill Projects in the World (11 issues a year)
Jaakko Pöyry Oy
Box 16, SF-00441 Helsinki, Finland

Monthly Paper Stock Statistics
National Assn. of Recycling Industries Inc.
330 Madison Ave., New York, N.Y. 10017

Monthly Pulpwood Summary
American Pulpwood Assn.
1619 Massachusetts Ave. N.W.
Washington, D.C. 20036

Newsprint Data (annual)
Canadian Pulp & Paper Assn.
2300 Sun Life Bldg., 1155 Metcalfe St.
Montreal, Que. H3B 2X9, Canada

Nonwovens Markets (25 issues a year)
Miller Freeman Publications
500 Howard St., San Francisco, Calif. 94105

Nonwovens World (bimonthly)
Miller Freeman Publications
500 Howard St., San Francisco, Calif. 94105

North American Fluff Pulp Markets and Prospects for 1986-96
Marketing/Technology Service Inc.
4100 South Seventh St., Kalamazoo, Mich. 49009

Official Board Markets (weekly)
Harcourt Brace Jovanovich Inc.
111 E. Wacker Dr., Chicago, Ill. 60601

PPI/International Factbook (biennial)
Miller Freeman Publications
500 Howard St., San Francisco, Calif. 94105

PPI/International Pulp & Paper Directory (biennial)
Miller Freeman Publications
500 Howard St., San Francisco, Calif. 94105

PPI/PULP & PAPER INTERNATIONAL (monthly)
Miller Freeman Publications
Chaussée de Charleroi 123a, Bte 5
B-1060 Brussels, Belgium

also 500 Howard St., San Francisco, Calif. 94105

Paper (semi-monthly)
Benn Publications Ltd.
Sovereign Way, Tonbridge, Kent TN9 1RW, U.K.

Paper Age (monthly)
Business Press Inc.
70 Oak St., Norwood, N.J. 07648

Paper Capacity Report (annual)
European Paper Institute
42, rue Galilée, F- 75116 Paris, France

Paper Chemicals (1987)
Frost & Sullivan Inc.
106 Fulton St., New York, N.Y. 10038

The Paper Distribution Industry (annual)
National Paper Trade Assn.
111 Great Neck Road, Great Neck, N.Y. 11021

Paper, Film & Foil Converter (monthly)
Maclean-Hunter Publishing Corp.
300 W. Adams St., Chicago, Ill. 60606

Paper Industry Equipment (bimonthly)
Hatton Brown Publishers
610 S. McDonough St., Montgomery, Ala. 36197

Paper Industry Monthly
Thomas P. Clephane and Jeanne Carroll
Morgan Stanley, Investment Research
1251 Ave. of the Americas, New York, N.Y. 10020

Paper Merchant Performance (annual)
National Paper Trade Assn.
111 Great Neck Road, Great Neck, N.Y. 11021

Paper Merchant Sales Report (monthly)
National Paper Trade Assn.
111 Great Neck Road, Great Neck, N.Y. 11021

Paper Packaging Monitor (monthly)
Resource Information Systems Inc.
110 Great Road, Bedford, Mass. 01730

Paper, Paperboard, Wood Pulp Capacity (annual)
American Paper Institute
260 Madison Ave., New York, N.Y. 10016

Paper, Paperboard & Wood Pulp/Monthly Statistical Summary
American Paper Institute
260 Madison Ave., New York, N.Y. 10016

Paper Production Report (weekly)
American Paper Institute
260 Madison Ave., New York, N.Y. 10016

Paper Sales (monthly)
Harcourt Brace Jovanovich Inc.
120 W. Second St., Duluth, Minn. 55802

Paper Trader (monthly)
Resource Information Systems Inc.
110 Great Road, Bedford, Mass. 01730

Paper Year Book (annual)
Harcourt Brace Jovanovich Inc.
120 W. Second St., Duluth, Minn. 55802

Paperboard Packaging (monthly)
Harcourt Brace Jovanovich Inc.
7500 Old Oak Blvd., Cleveland, Ohio 44130

Papercast (monthly)
Communication Conseil International
96, rue Montmartre, 75002 Paris, France

Pima (monthly)
Pima (Paper Industry Management Assn.)
2400 E. Oakton St., Arlington Heights, Ill. 60005

Pima Pulp & Paper Mill Catalog (annual)
Pima (Paper Industry Management Assn.)
2400 E. Oakton St., Arlington Heights, Ill. 60005

Pocket Pal/Graphic Arts Production Handbook
International Paper Co.
2 Manhattanville Road, Purchase, N.Y. 10577

Post's Pulp & Paper Directory
(*see* Lockwood-Post's Directory)

Presstime (monthly)
American Newspaper Publishers Assn.
Box 17407, Dulles International Airport
Washington, D.C. 20041

Printing and Graphic Arts Buyers (annual)
Hilary House Publishers Inc.
1033 Channel Dr., Hewlett Harbor, N.Y. 11557

Probable Levels of R&D Expenditures in 1987—Forecast and Analysis
Battelle
505 King Ave., Columbus, Ohio 43201-2693

Production, Prices, Employment & Trade in Northwest Forest Industries (quarterly)
Pacific Northwest Forest & Range Experiment
Station, Forest Service, U.S. Dept. of Agriculture
809 N.E. 6th Ave., Portland, Ore. 97232

Projected Pulp and Paper Mills in the World (annual)
Food & Agriculture Organization, United Nations
Via delle Terme di Caracalla, I-00100 Rome, Italy

Publication Papers 3 (proceedings of PULP & PAPER INTERNATIONAL's 3rd International Publications Conference, 1986)
Miller Freeman Publications
500 Howard St., San Francisco, Calif. 94105

PULP & PAPER (monthly except twice in November)
Miller Freeman Publications
500 Howard St., San Francisco, Calif. 94105

PULP & PAPER Buyers Guide (annual)
Miller Freeman Publications
500 Howard St., San Francisco, Calif. 94105

Pulp & Paper Canada (monthly)
Southam Business Publications
310 Victoria Ave., Westmount, Que. H3Z 2M9, Canada

Pulp & Paper Canada Annual and Directory (annual)
Southam Business Publications
310 Victoria Ave., Westmount, Que. H3Z 2M9, Canada

Pulp and Paper Capacities (annual)
Food & Agriculture Organization, United Nations
Via delle Terme di Caracalla, I-00100 Rome, Italy

Pulp & Paper Dictionary
By John R. Lavigne
Miller Freeman Publications
500 Howard St., San Francisco, Calif. 94105

Pulp and Paper Journal (9 times a year and a directory/desk calendar)
Maclean-Hunter Ltd.
777 Bay St., Toronto, Ont. M5W 1A7, Canada

Pulp and Paper Mills (Catalog No. 36-204—annual)
Statistics Canada
Publications Distribution, User Services Div.
Ottawa, Ont. K1A 0T6, Canada

Pulp & Paper Mills in the U.S. & Canada (map, 1988)
Miller Freeman Publications
500 Howard St., San Francisco, Calif. 94105

PULP & PAPER Project Report (monthly, with semiannual Mill-by-Mill Listings supplement)
Miller Freeman Publications
500 Howard St., San Francisco, Calif. 94105

Pulp and Paper/Quarterly Statistics (quarterly)
OECD/Organization for Economic Cooperation
and Development, Paris, France
OECD Publications Center
1750 Pennsylvania Ave. N.W., Washington, D.C. 20006

Pulp & Paper Statistics (annual)
Japan Paper Assn.
Kami-Parapu Kaikan Bldg., 9-11 Ginza 3-chome
Chuo-ku, Tokyo, Japan

PULP & PAPER WEEK (weekly—48 times a year)
Miller Freeman Publications
500 Howard St., San Francisco, Calif. 94105

Pulp Buyers Survey
PAPIS Ltd.
Collingham House, Gladstone Road
Wimbledon, London SW19 1QH, U.K.

Pulpwood and Wood Residue Statistics (Catalog No. 25-001—monthly)
Statistics Canada
Publications Distribution, User Services Div.
Ottawa, Ont. K1A 0T6, Canada

Reference Tables (annual)
Canadian Pulp & Paper Assn.
2300 Sun Life Bldg., 1155 Metcalfe St.
Montreal, Que. H3B 2X9, Canada

SCPF Annual Report
Swedish Pulp and Paper Assn.
Villagatan 1, S-114 32 Stockholm, Sweden

SOS/Sources of Supply Buyers Guide (annual)
Advertisers & Publishers Service Inc.
300 N. Prospect Ave., Park Ridge, Ill. 60068

Short-term Review of International Pulp & Paper Markets, Worldwide (quarterly)
Jaakko Pöyry Oy
Box 16, SF-00441 Helsinki, Finland

Specialty Papers and Boards Worldwide Trends & Developments
Data-Transcripts
Box 14, Dorking, Surrey RH5 4YN, U.K.

Specialty Papers and Products Record (monthly)
Data-Transcripts
Box 14, Dorking, Surrey RH5 4YN, U.K.

Statistical Bulletin (monthly)
Canadian Pulp & Paper Assn.
2300 Sun Life Bldg., 1155 Metcalfe St.
Montreal, Que. H3B 2X9, Canada

Statistical Bulletin/Containerboard Shipments, Consumption, Inventory (monthly)
Fibre Box Assn.
5725 E. River Road, Chicago, Ill. 60631

Statistics of Paper, Paperboard & Wood Pulp (annual)
American Paper Institute
260 Madison Ave., New York, N.Y. 10016

Statistics Year 1986
European Paper Institute
42, rue Galilée, F-75116 Paris, France

Synthetic Polymers and the Paper Industry
By Vladimir M. Wolpert
Miller Freeman Publications
500 Howard St., San Francisco, Calif. 94105

Tappi Journal (monthly)
TAPPI (Technical Assn. of Pulp & Paper Industry)
15 Technology Park South, Norcross, Ga. 30092

Tappi Journal Directory (annual)
TAPPI (Technical Assn. of Pulp & Paper Industry)
15 Technology Park South, Norcross, Ga. 30092

Thermal & Dielectric Papers—Technology, Markets & Company Data
Data-Transcripts
Box 14, Dorking, Surrey RH5 4YB, U.K.

This Week (weekly—48 times a year)
Edited by PULP & PAPER INTERNATIONAL
123a Chaussée de Charleroi, Bte 5
B-1060 Brussels, Belgium

Timber Mart—South (monthly)
Timber Mart—South Inc.
Box 1278, Highlands, N.C. 28741

Transport & Handling (Vols. 6, 5, 4, covering PPI's International Symposiums on Transport & Handling in the Pulp & Paper Industry in 1985, 1983, and 1980, respectively)
Miller Freeman Publications
500 Howard St., San Francisco, Calif. 94105

Unbleached Kraft Markets (Vols. 1 and 2, covering symposiums in 1984 and 1986, respectively)
Miller Freeman Publications
500 Howard St., San Francisco, Calif. 94105

Uncoated Groundwood Papers (Vol. 3, covering Uncoated Groundwood Papers Conference, 1987)
Miller Freeman Publications
500 Howard St., San Francisco, Calif. 94105

U.S. Exports of Pulp, Paper, Paperboard and Converted Products (annual)
American Paper Institute
260 Madison Ave., New York, N.Y. 10016

U.S. Exports of Wastepaper by Destination (annual)
American Paper Institute
260 Madison Ave., New York, N.Y. 10016

U.S. Imports, Schedule A, Commodity by Country (Catalog FT135—includes pulp and paper grades; monthly)
Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402

U.S. Industrial Outlook
U.S. Dept. of Commerce, International Trade Administration, Superintendent of Documents
Washington, D.C. 20402

U.S. Market for Household Paper Products: A Strategic Marketing Analysis and Biennial Review
Business Trend Analysts
1271 Jericho Turnpike, Commack, N.Y. 11725

U.S. Woodpulp Data (monthly)
American Paper Institute
Pulp, Materials & Technology Group
260 Madison Ave., New York, N.Y. 10016

Walden's ABC Guide and Paper Production Yearbook (annual)
Walden-Mott Corp.
475 Kinderkamack Road, Oradell, N.J. 07649

Walden's Fiber & Board Report (semimonthly)
Walden-Mott Corp.
475 Kinderkamack Road, Oradell, N.J. 07649

Walden's Handbook/For Paper Salespeople and Buyers
Walden-Mott Corp.
475 Kinderkamack Road, Oradell, N.J. 07649

Walden's Paper Catalog (2 times a year, in 6 regional editions)
Walden-Mott Corp.
475 Kinderkamack Road, Oradell, N.J. 07649

Walden's Paper Report (twice monthly)
Walden-Mott Corp.
475 Kinderkamack Road, Oradell, N.J. 07649

Who's Who in Paper Distribution (annual)
National Paper Trade Assn.
111 Great Neck Road, Great Neck, N.Y. 11021

Wisconsin Forest Products Price Review (three segments, quarterly or semi-annually)
University of Wisconsin
432 North Lake St., Madison, Wis. 53706

Wood Fibre Northwest (quarterly)
Wood Fibre Northwest
Box 572, Albany, Ore. 97321

Wood Pulp & Fiber Statistics (annual)
American Paper Institute
Pulp, Materials & Technology Group
260 Madison Ave., New York, N.Y. 10016

World Pulp Monthly
Resource Information Systems Inc.
110 Great Road, Bedford, Mass. 01730

SPECIAL REPORTS AND SURVEYS (generally priced at least $1,000)

CTMP—Technical and Marketing Progress 1985/86 (1987)
Celpap Consultants Ltd.
The Runnymede Malt House, Runnymede Road, Egham,
Surrey TW20 9BO, U.K.

Carbonless Copy Paper: A Specialized Commodity (1986)
Gorham International Inc.
Box 8, Gorham, Maine 04038

Coated Woodfree Printing Papers: A Technical Evaluation of European Imports into the North American Market (1987)
Gorham International Inc.
Box 8, Gorham, Maine 04038

Containerboard Outlook—Western Europe (1987)
Corporate Development Consultants Ltd.
Barry House, 20-22 Worple Road
Wimbledon, London SW19 4DH, U.K.

The Dynamic Market Demand for Uncoated Woodfree Printing and Writing Papers (1983)
Gorham International Inc.
Box 8, Gorham, Maine 04038

The European Market for Baby Diapers (1987)
Corporate Development Consultants Ltd.
Barry House, 20-22 Worple Road
Wimbledon, London SW19 4DH, U.K.

Fast-Growing Plantations—Impact on the International Market Pulp, Linerboard and Woodfree Paper Businesses
Jaakko Pöyry Oy
Box 16, SF-00441 Helsinki, Finland

Financial Performance of Major Forest Product Companies in Western Europe and North America (1986)
Jaakko Pöyry Oy
Box 16, SF-00441 Helsinki, Finland

FormsMark I—The Changing Distribution Channels & Marketing Strategies in the Forms Industry
International Business Forms Industries Inc.
1730 N. Lynn St., Arlington, Va. 22209-2096

FormsMark II—The Short-Run Forms Market
International Business Forms Industries Inc.
1730 N. Lynn St., Arlington, Va. 22209-2096

FormsMark III—The Impact of the Intelligent Copier/Printer on the Continuous Forms Market
International Business Forms Industries Inc.
1730 N. Lynn St., Arlington, Va. 22209-2096

FormsMark IV—The Future of Forms in the Banking Industry
International Business Forms Industries Inc.
1730 N. Lynn St., Arlington, Va. 22209-2096

FormsMark V—Opportunities for Forms Manufacturers in the Pressure Sensitive Label Market
International Business Forms Industries Inc.
1730 N. Lynn St., Arlington, Va. 22209-2096

Future of Catalog Markets and Production through 1989 (6 vols.)
Strategic Futures Inc.
595 Madison Ave., New York, N.Y. 10022

Future of Insert/Flyer Marketing and Production through 1990 (2 vols.)
Strategic Futures Inc.
595 Madison Ave., New York, N.Y. 10022

Ink Jet Printing: Current Status and Future Prospects (1984)
Gorham International Inc.
Box 8, Gorham, Maine 04038

Ink Jet Printing Papers (1987)
Gorham International Inc.
Box 8, Gorham, Maine 04038

Ink Jet Printing: Printing Industry Applications and Impacts (1985)
Gorham International Inc.
Box 8, Gorham, Maine 04038

Labelling in Western Europe (1987)
Corporate Development Consultants Ltd.
Barry House, 20-22 Worple Road
Wimbledon, London SW19 4DH, U.K.

Light Weight Coated Printing Papers: A Technical Evaluation of European Imports into the North American Market (1987)
Gorham International Inc.
Box 8, Gorham, Maine 04038

Liquid Packaging in the EEC (1987)
Corporate Development Consultants Ltd.
Barry House, 20-22 Worple Road
Wimbledon, London SW19 4DH, U.K.

Market Update: An Analysis of the Plastic vs Paper Battle (#861, 1986)
Strategic Research Center
One Commerce Park Square
23200 Chagrin Blvd., Cleveland, Ohio 44122

Opportunities in Wood-Containing Publication and Business Papers
Jaakko Pöyry Oy
Box 16, SF-00441 Helsinki, Finland

Outlook for Selected Folding Boxboard Markets 1985-1990-2000 (1985)
Phillip Townsend Associates Inc.
Box 90327, Houston, Texas 77290

Outlook for the Uncoated Free Sheet Industry in North America (Supply, Demand and Price Projections) (1987)
Andover International Associates
25 Cherry St., Danvers, Mass. 01923

Outlook for World Paper Markets up to 2000
Jaakko Pöyry Oy
Box 16, SF-00441 Helsinki, Finland

Paper and Pulp to 1995 (#134, 1986)
The Freedonia Group Inc.
2940 Noble Road, Cleveland, Ohio 44121

Paper Machine Reports (to customer specifications)
Jaakko Pöyry Oy
Box 16, SF-00441 Helsinki, Finland

Paper vs Plastics (#148) (1986)
The Freedonia Group Inc.
2940 Noble Road, Cleveland, Ohio 44121

Polyethylene Envelopes: Worldwide Markets and U.S. Technologies 1987-1992 (1988)
Phillip Townsend Associates Inc.
Box 90327, Houston, Texas 77290

Polyethylene Film Markets and Technologies (1987)
Phillip Townsend Associates Inc.
Box 90327, Houston, Texas 77290

Printing Markets Outlook/Paper Grades Outlook: 1987-89 (2 vols.)
Strategic Futures Inc.
595 Madison Ave., New York, N.Y. 10022

Prospects for CTMP-Containing Papers in the Woodfree Sector (1987)
Celpap Consultants Ltd.
The Runnymede Malt House, Runnymede Road
Egham, Surrey TW20 9BO, U.K.

Prospects for Linerboard Manufacture in Non-Traditional Regions (1987)
Andover International Associates
25 Cherry St., Danvers, Mass. 01923

Pulp and Paper Industry in Eastern Europe (1987)
Indufor Ky
Kapteeninkatu 14, Box 121, SF-00141 Helsinki, Finland

Pulp Mill Reports (to customer specifications)
Jaakko Pöyry Oy
Box 16, SF-00441 Helsinki, Finland

Pulp Price Trends (3 vols. per year)
Celpap Consultants Ltd.
The Runnymede Malt House, Runnymede Road
Egham, Surrey TW20 9BO, U.K.

Release Base Papers: Business Opportunity for Papermakers (1987)
Gorham International Inc.
Box 8, Gorham, Maine 04038

Series of Data Base Reports on Grades such as Coated, Tissue, Linerboard, SBS, etc.
Communication & Information Services
Box 5923, Concord, Calif. 94524

Supercalendered Uncoated Groundwood Paper Markets in North America and Europe (1986)
Resource Information Systems Inc.
100 Great Road, Bedford, Mass. 01730

Thermal Printing Papers—an Evaluation of Business in a Growing Market (1983)
Gorham International Inc.
Box 8, Gorham, Maine 04038

Timber Inventories in the South: The Availability and Price of Wood Fibre and Stumpage Through 2015 (1986)
Resource Information Systems Inc.
110 Great Road, Bedford, Mass. 01730

Timber Situation in 12 Southern States: Projections for Forest Area, Inventory, Growth, Harvest and Prices Through 2015 (1985)
Resource Information Systems Inc.
110 Great Road, Bedford, Mass. 01730

U.S. Printing and Writing Paper Study (2 vols.)
Resource Information Systems Inc.
110 Great Road, Bedford, Mass. 01730

Wood Free Premium Coated Printing Papers: A Technical Evaluation of European Imports into the North American Market.
Gorham International Inc.
Box 8, Gorham, Maine 04038

World Kraftliner Study (1987)
Resource Information Systems Inc.
110 Great Road, Bedford, Mass. 01730

World Market Pulp Study: Outlook for Chemical Paper Grade Market Pulp Through 1995 (1985, 2 vols.)
Resource Information Systems Inc.
110 Great Road, Bedford, Mass. 01730

World Paper and Board (#163 1987)
The Freedonia Group Inc.
2940 Noble Road, Suite 200, Cleveland, Ohio 44121

Yeast from Spent Sulphite Liquor: Manufacture and Marketing
Arnold Services
106 Runcorn Road, Moore, Warrington WA4 6UB, U.K.

SPECIAL MARKET REPORTS (list on request to publishers)

Andover International Associates Inc.
25 Cherry St., Danvers, Mass. 01923

CIS Communication & Information Services
Box 5923, Concord, Calif. 94524

Copeland Economics Group
Box 8207, Stamford, Conn. 06905

Corporate Development Consultants Ltd.
Barry House, 20-22 Worple Road
Wimbledon, London SW19 4DH, U.K.

Data Resources
24 Hartwell Ave., Lexington, Mass. 02173

Euro-Data Analysts
Box 13, Dorking, Surrey RH5 4YL, U.K.

Miller Freeman Publications
500 Howard St., San Francisco, Calif. 94105

Frost & Sullivan Inc.
106 Fulton St., New York, N.Y. 10038

Gorham International Inc.
Box 8, Gorham, Maine 04038

Indufor Ky
Kapteeninkatu 14, Box 121, SF-00141 Helsinki, Finland

International Business Forms Industries Inc.
1730 N. Lynn St., Arlington, Va. 22209-2096

Arthur D. Little Inc.
Acorn Park, Cambridge, Mass. 02140

Marketing/Technology Service
4100 South Seventh St., Kalamazoo, Mich. 49009

PAPIS Ltd.
Collingham House, Gladstone Road
Wimbledon, London SW19 1QH, U.K.

Jaakko Pöyry Oy
Box 16, SF-00441 Helsinki, Finland

Predicasts Inc.
11001 Cedar Ave., Cleveland, Ohio 44106

Resource Information Systems Inc.
100 Great Road, Bedford, Mass. 01730

SRI International
333 Ravenswood, Ave., Menlo Park, Calif. 94025

Strategic Futures Inc.
595 Madison Ave., New York, N.Y. 10022

Phillip Townsend Associates Inc.
Box 90327, Houston, Texas 77290

Walker Wiener Associates Inc.
540 North State Road, Briarcliff Manor, N.Y. 10510

COMPANY PROFILES

This section is a directory of pulp- and papermaking facilities in the U.S. and Canada. An alphabetical list, which follows immediately, contains all company names.

Operations are listed under the name of the corporate owner, except when the owner is not in the pulp/paper/board industry. Subsidiaries and joint ventures in U.S. and Canada are included under the parent firm and cross-indexed in the alphabetical list. Foreign operations are not listed.

All pulp produced at a millsite, whether shipped as market pulp or consumed onsite in papermaking, is counted.

Profiles are divided into two parts:

MAJOR FIRMS (1,000-tpd capacity)

Included in this section are companies with daily production capacity of at least 1,000 short tons (or 900 metric tons) of pulp/paper/board combined. Sales and earnings figures for 1984 through 1987 are given (where available) and a brief description of each company follows. Pulp and paper/board production sites are listed, with capacity and grades.

OTHER FIRMS (under 1,000-tpd capacity)

Pulp and paper/board production sites are listed, with capacity and grades.

FINANCIAL DATA

All sales and earnings figures are shown in U.S. dollars, unless indicated "C$" for Canadian dollars.

PRODUCTION DATA

All capacity production data are set in short tons of 2,000 lb, unless specifically indicated as metric.

To convert to metric tons: multiply by 0.90718

To convert to short tons: multiply by 1.1023

Alphabetical list of mills

*Indicates companies and their subsidiaries producing 1,000 tpd or more. Parent companies are shown in parentheses after names of subsidiaries. A shortened name is used or abbreviations as shown at right.

Abbreviations used:

BC = Boise Cascade Corp.
BCFP = British Columbia Forest Products
CPFP = Canadian Pacific Forest Products
DI = Daishowa International
G-P = Georgia Pacific Corp.
GNN = Great Northern Nekoosa Corp.
ITT = ITT Rayonier Inc.
IP = International Paper Co.
IRI = Interstate Resources Inc.
JR = James River Corp.
JSC = Jefferson Smurfit Corp.
K-C = Kimberly-Clark Corp.
L-P = Louisiana-Pacific Corp.
MB = MacMillan Bloedel Ltd.
P&W = Parsons & Whittemore Inc.
PIC = Paperboard Industries Corp.
P&G = Procter & Gamble Co.
PCA = Packaging Corp. of America
PFA = Ponderosa Fibres of America
Q&O = Quebec & Ontario Paper Co. Ltd.
SKB = Stora Kopparbergs Bergslags AB
T-I = Temple Inland Inc.
USG = United States Gypsum Co.

A

APL Corp.
*Abitibi-Price Inc.
*Acadia Forest Products Ltd. (Repap)
*Alabama Kraft Co. (Mead)
*Alabama River Pulp Co. (P&W)
Alaska Pulp Corp.
Alberta Newsprint Co. Ltd.
Alcan Aluminium (proposed newsprint mill, Vanderhoof, B.C.)
Allied Paper Inc.
Alpha Cellulose Corp.
*Alton Packaging Corp. (JSC)
American Fibrit Inc.
American Paper Products Co.
American Tissue Co.
Amricon Corp. (Kerwin)
*Appleton Papers Inc.
*Arkansas Kraft Corp. (Green Bay)
*Arvey Corp. (IP)
Ashuelot Paper Co.
*Atholville Pulp Inc. (Noranda)
*Atlantic Coast Paperboard Inc. (Newark)
Atlantic Packaging Products Ltd.
Atlas Paper Mills Corp.
Augusta Kraft Co. (proposed kraft pulp/linerboard mill for Atlanta, Ga.)
*Augusta Newsprint Co. (Abitibi)
*Austell Box Board Corp. (Caraustar)

B

B.J. Fibres (Ponderosa)
Badger Paper Mills Inc.
Baldwinville Products Inc. (Erving)
Banner Fibreboard Co.
Bato Co. Inc. (Brant-Allen)
*Bear Island Paper Co. (Brant-Allen)
*Beaver Wood Fibre Co. (G-P)
*Beckett Paper Co. (IP)
*Belkin Inc. (PIC)
Beloit Box Board Co. Inc.
Bemis Co. Inc. (Petratex)
Bennett Fleet Inc.
*Bergstrom Paper Co. (Glatfelter)
Beveridge Paper Co. (Simkins)
*Big M Paperboard Inc. (PIC)
Bio-Tech Mills Inc.
*Blandin Paper Co. (BCFP)
*Boise Cascade Canada (BC)
*Boise Cascade Corp.
*Boise Southern Co. (BC)
*Bowater Carolina Co. (Bowater)
*Bowater Inc.
*Bowater Mersey Paper Co. (Bowater)
*Bowater Southern Paper Co. (Bowater)
Brandywine Paper Mills Inc.
*Brant-Allen Industries Inc.
*British Columbia Forest Products Ltd.
*Brokaw Div. (Wausau)
Brown Products Inc.
*Brunswick Pulp & Paper Co. (Mead, Scott)
*Buckeye Cellulose Corp. (P&G)
Building Products of Canada Ltd.
Burrows Paper Corp.
Burrows Southern Corp. (Burrows)
Byron Weston Co. (Crane)

C

*CIP Inc. (CPFP)
CKF Inc. (Minas Basin)
CPM Inc.
*California Paperboard Co. (Newark)
*Canadian Gypsum Co. Ltd. (USG)
*Canadian Pacific Forest Products Ltd.
*Canfor Corp.
*Caraustar Industries Inc.
*Cariboo Pulp & Paper Co. (Daishowa, Weldwood)
*Carolina Paper Board Corp. (Caraustar)
*Carotell Paper Board Corp. (Caraustar)
*Cascades Dominion Inc. (Cascades)
*Cascades Inc.
*Catawba Newsprint Co. (Bowater)
*Celgar Pulp Co. (BCFP)
Cellu Products, Sealed Air Corp.
Cellu Tissue Corp.
Celotex Corp.
Chagrin Fibers Inc. (McIntyre)
*Champion Forest Products (Alberta) Ltd. (Champion)
*Champion International Corp.
Chase Bag Co.
*Chattanooga Paperboard Corp. (Caraustar)
Cheney Pulp & Paper Co.
*Chesapeake Corp.
Chesapeake Paperboard Co.
*Chicago Paperboard Corp. (Caraustar)
ChinAm Inc.
*Cincinnati Paperboard Corp. (Caraustar)
Cleaners Hanger Co.
Climax Mfg. Co.
Clinch River Corp.
Columbia Corp.
Concel Inc. (APL)
Connelly Containers Inc. of Philadelphia
*Consolidated-Bathurst Inc.
Consolidated Packaging Corp.
*Consolidated Papers Inc.
*Container Corp. of America (JSC)
*Continental Forest Industries (Federal)
Contoocook Valley Paper Co.
Converters Paperboard Inc.
Cornwall Paper Mills Co.
Corrugated Services Inc.
Cottrell Paper Co. Inc.
Coy Paper Co.
Crane & Co. Inc.
Crestbrook Forest Industries Ltd.
Crocker Technical Papers Inc.
*Crown Forest Industries Ltd.
*Crown Simpson Co. (Simpson)
*Crown Zellerbach Corp. (JR)
*Crystal Tissue Co.

D

*Daishowa International
*Daishowa America Co. Ltd. (DI)
*Daishowa Canada Co. Ltd. (DI)
The Davey Co.
Deerfield Specialty Papers Inc. (Simkins)
*Désencrage Cascades Inc. (Cascades)
Detroit River Paper Co.
Dexter Corp.
Diamond Fiber Products Inc.
*Dominion Cellulose Ltd. (CPFP/CIP)
*Domtar Inc.
Dong Bang
*Donohue Inc.
*Donohue Matane Inc. (Donohue)
*Donohue-Normick Inc. (Donohue)
*Donohue St-Félicien Inc. (BCFP, Donohue)
*Dunn Paper Co. (JR)

E

EHV-Weidmann Industries Inc.
*Eastern Fine Paper Inc. (Eddy)
Eastman Kodak Co.
Eaton-Dikeman Div. (Filtration)
*Ecusta Corp. (Glatfelter)
*Eddy Paper Co. Ltd.
Equitable Bag Co. Inc.
Erving Paper Mills
Esleeck Mfg. Co. Inc.
*Eurocan Pulp & Paper Co.
Evanite Fiber Corp.
Exton Paper Manufacturers Inc.

F

FSC Paper Corp
Falls Tissue Inc. (St. Raymond)
*Federal Paper Board Co. Inc.
*Fibreboard Corp. (L-P, Gaylord)
Fibre Form Corp.
Fibreco Export Inc.
Filter Materials Inc.
Filtration Sciences Corp.
Finch, Pruyn & Co.
*Finlay Forest Products Ltd. (BCFP)
Fitchburg Paper Co. (Rolland)
*Flambeau Paper Corp. (Pentair)
Fletcher Paper Co.
Flower City Tissue Mills Co.
J. Ford & Co. Ltd.
Forex (Normick Perron)
*Fort Howard Corp.
Fort Orange Paper Co. Inc.
Fox Paper Div. (Erving)
Fox River Paper Co.
*Franklin Boxboard Corp. (Newark)
*Fraser Inc. (Noranda)
French Paper Co.
Fripp Fibre Forms Inc.

G

*Garden State Paper Co.
*Gaspesia Pulp & Paper Co. (Abitibi)
*Gaylord Container Ltd.
Georgia Bonded Fibers Inc.
*Georgia Kraft Co. (Macon, Mead, T-I)
*Georgia-Pacific Corp.
*Gilbert Paper Co. (Mead)
*Gilman Paper Co.
Glassine Canada Inc. (Simkins)
*P.H. Glatfelter Co.
*Gold River Newsprint Ltd. Partnership (CPFP/CIP)
*Gorham Absorbent Products (JR)
W.R. Grace & Co.
*Grays Harbor Paper Co. (IP, ITT)
*Great Lakes Forest Products Ltd. (CPFP)
*Great Northern Nekoosa Corp.
*Great Northern Paper (GNN)
*Great Southern Paper (GNN)
*Green Bay Packaging Inc.
Greif Board Corp.
Groveton Paper Board Inc.
*Gulf States Paper Corp.

H

Halifax Paper Board Co. Inc.
Halltown Paperboard Co.
*Hammermill Paper Co. (IP)
*Harding Jones Paper Co. (Simpson)
Harriman Paperboard Corp. (Clinch River)
*Haverhill Paperboard Co. (Newark)
Hennepin Paper Co.
Henry Molded Products Inc.
Hercules Inc.
Hinsdale Products Co. Inc.
Hoague-Sprague Corp. (Papertech)
Hollingsworth & Vose Co.
Howard Paper Mills Inc.
*Howe Sound Pulp & Paper Ltd (Canfor)

I

*ITT Rayonier Inc.
Imperial Mfg. Co.
*Les Industries Cascades Ltée (Cascades)
*Inland Container (T-I)
Inland Empire Co.
*Intercontinental Pulp Co. (Canfor)
*International Paper Co.
*Interstate Intercorr Corp. (IRI)
*Interstate Paper Corp. (IRI)
*Interstate Resources Inc.
*Irving Pulp & Paper Ltd.
*Irving Tissue Co. (Irving)
*Island Paper Mills Ltd. (MB, Noranda)
Ivex Corp.

J

Jackson Paper Mfg. Inc.
*Jacksonville Kraft Paper Co. (Stone)
*James River Corp.
*James River-Marathon Ltd. (JR)

K

*KVP Group (JR)
Keiding Inc.
Kenaf International
*Kenogami Groundwood Paper Mill (Abitibi)
Kerwin Paper Co.
Keyes Fibre Co.
Kieffer Paper Mills Inc.
*Kimberly-Clark Corp.
*Kimberly-Clark of Canada (K-C)
*Kruger Inc.

L

*Lake Superior Paper Industries (Pentair)
*Lake Utopia Paper Ltd. (Irving)
Laurel Hill Paper Co.
Lawrence Paperboard Corp. (Clinch River, Newark.)
*Leaf River Forest Products (GNN)
Leggett & Platt Inc. (U.S. Packaging)
Lincoln Paper Co.
Lincoln Pulp & Paper Co.
Linweave Fine Papers Inc.
Little Rapids Corp.
*Longview Fibre Co.
Los Angeles Paper Box & Board Mills
*Louisiana-Pacific Corp.
Lowe Paper Co. (Simkins)
Lydall Inc.
Lyons Falls Pulp & Paper Inc.

M

MH Dielectrics Inc.
*James Maclaren Industries Inc. (Noranda)
*MacMillan Bloedel Ltd.
*Macon Kraft Inc.
Madison Paper Corp.
Makin Pulp & Paper Ltd.
Malette Kraft Pulp & Power
Manchester Board & Paper Co.
Manfor Ltd.
Manistique Papers Inc.
Manning Paper Co. (Lydall)
*Manville Forest Products Corp.
Marcal Paper Mills Inc. (also see: St. Raymond)
Marlboro Paper Inc.
Martisco Paper Co. Inc.
Maryland Paper Box Co. (Reading/White Hall)
McIntyre Paper Co. Inc.
*Mead Corp.
Mechanic Falls Paper Mill (St. Raymond)
Menasha Corp.
Menominee Paper Co. Inc.
Merrimac Paper Co. Inc.
*Miami Paper Corp. (Pentair)
Michigan Paperboard Corp.
*Mid-America Packaging Inc. (Gaylord)
Middleton Packaging Inc.
*Middletown Paperboard Co. (Newark)
*Midtec Paper Corp. (Repap)
Mi Ho Paper Co.
Millar Western Pulp Ltd.
Millen Industries Inc.
Minas Basin Pulp & Power Co. Ltd.
*Miramichi Pulp & Paper Co. Inc. (Repap)
*Mobile Paperboard Corp. (Newark)
Mohawk Paper Mills Inc.
Mohawk Pulp Co. Ltd. (St. Raymond)
Mohawk Valley Paper Co. (Burrows)
Monadnock Paper Mills Inc.
Monroe Paper Co. (also see: JSC)
Morris Paper Board Co. (ChinAm)
Mosinee Paper Corp.

N

*NBIP Ltd. (CPFP/CIP)
NVF Co.
*Nabisco Inc. (Federal)
*Natick Paperboard Co. (Newark)
*National Gypsum Co.
*Nekoosa Packaging Corp. (GNN)
*Nekoosa Papers Inc. (GNN)
*Newark Group Inc.
Newman & Co. Inc.
Newsprint South Inc.
*Newton Falls Paper Mill Inc. (SKB)
*Niagara of Wisconsin Paper Corp. (Pentair)
Nicolet Inc.
*Nicolet Paper Co. (IP)
*Nitec Paper Corp. (Cascades, Repap)
Nolichucky Industries Corp.
*Noranda Forest Inc.
Norfolk Paper Co. Inc. (McIntyre)
Normick Perron Inc./Forex Group Inc. (proposed newsprint mill, Val d'Or, Que.)
North End Paper Co. (Flower)
*North Pacific Paper Co. (Weyerhaeuser)
*Northwood Pulp & Timber Ltd. (Mead, Noranda)

O

Ohio Pulp Mills Inc.
*Olin Corp. (Glatfelter)
*Ontario Paper Co. Ltd. (Q&O)
*Owens-Illinois Inc. (GNN)

P

Pabco Paper Products Co.
Pacific Coast Packaging Corp.
*Packaging Corp. of America
*Palmyra Paperboard Co. (PIC)
Paper Service Mills Inc.
*Paperboard Industries Corp.
Paper-Pak Products Inc.
Papertech Corp.
*Papiers Cascades (Cabano) Inc. (Cascades)
*Papier Kingsey-Falls (Cascades)
Parsons Paper (NVF)
*Parsons & Whittemore Inc.
Pejepscot Paper Co. Inc. (St. Raymond)
Penacook Fibre Co.
Penntech Papers Inc.
*Pentair Inc.
Perkins Papers Ltd.
Perkit Folding Box Corp.
Petratex Paper Co. Inc.
*Plainwell Paper Co. Inc. (Simpson)
*Ponderay Newsprint Co. (CPFP/GLFP)
Ponderosa Fibres of America
Ponderosa Georgia Corp. (PFA)
Ponderosa Pulp Products Corp. (PFA)
Ponderosa of Tennessee (PFA)
Ponderosa Paper Products Cancel Inc. (APL)
V. Ponte & Sons Inc.
*Pope & Talbot Inc.
Port Huron Paper Corp. (Kepaco, Eddy)
*Pentair Inc.
Portais Inc.
Port Townsend Paper Corp.
*Potlatch Corp.
Potsdam Paper Mills (Little Rapids)
Prairie State Paper Mills (Ivex)
Preco Corp. (Lincoln Pulp & Paper)
*Premoid Corp. (JR)
*Price Co. (Abitibi)
*Price-Wilson Inc. (Abitibi)
*Prince Albert Pulp & Paper (Weyerhaeuser)
* Prince George Pulp & Paper (Canfor)
*Procter & Gamble Co.
*Provincial Papers (Abitibi)
*Publishers Paper Co. (JSC)
Putney Paper Co. (Ashuelot)

Q

*Q.N.S. Paper Co. Ltd. (Q&O)
Quaker Oats Co., Paper Div.
*Quebec & Ontario Paper Co. Ltd.
Quesnel River Pulp Co. (also see: DI)
Quin-T Corp. New Hampshire
Quin-T Corp.-Pennsylvania

R

RPM Board & Carton Corp. (Converters Paperboard)
Rand Whitney Paperboard Corp.
*Reading Paper Board Corp. (Caraustar)
Reading/White Hall Paper Board Co.
Red Hook Paper Corp.
*Reed Inc.
*Reid Dominion Packaging Ltd. (Cascades)
*Repap Enterprises Corp.
Republic Paperboard Co.
Republic Gypsum Co. (Republic Paperboard)
*Rhinelander Paper Co. (Wausau)
*Riegel Custom Products Corp. (JR)
Rising Paper Co. (Fox River)
Robel Tissue Mills Inc. (APL)
G.E. Robertson & Co.
Robertson Paper Box Co. Inc. (Rand Whitney)
*Rock-Tenn Co.
Rolland Inc.
*Rothesay Paper Ltd. (Irving)

S

*St. Anne-Nackawick Pulp & Paper Co. (P&W)
*St. Joe Paper Co.
St. Mary's Paper Co.
St. Raymond Paper Co. (1983) Inc.
*St. Regis Paper Co. (Canada) Ltd. (Weldwood of Canada Ltd.)
Schoeller Technical Papers Inc.
*Scott Paper Co.
*Scott Maritimes Ltd. (Scott)
Seaman Paper Co. of Massachusetts Inc.
*Seminole Kraft Corp. (Stone)
Shawano Paper Mills (Little Rapids)
Shoreham Packaging Group. (Watervliet)
Shryock Bros. Inc.
Sierra Tissue Co. Inc.
*Simpson Paper Co.
*Simpson Pasadena Paper Co. (Simpson)
Simkins Industries Inc.
Simplex Industries Inc.
Simplicity Pattern Co. Inc.
*Skeena Cellulose Inc. (Repap)
*Jefferson Smurfit Corp.
*Smurfit Newsprint Corp. (JSC)
*Sonoco Products Co.
Sorg Paper Co. (Mosinee)
*F.F. Soucy Inc. (Brant-Allen)
*F.F. Soucy Inc. et Associés (Brant-Allen)
Southeast Newsprint Manufacturing Co.
*Southeast Paper Mfg. Co.
Southern Cellulose Products Inc.
Southern Specialty Paper Co. (Filtration)
*Southwest Forest Industries Inc. (Stone)
Southworth Co.
Spaulding Fibre Co. Inc.
Specialty Paper Mills Inc.
*Spruce Falls Power & Paper Co. Ltd. (K-C)
Statler Tissue Corp.
Stevens & Thompson Paper Co.
*Stone Container Corp.
*Stora Forest Industries (SKB)
*Stora Kopparbergs Bergslags AB
Strathcona Paper Co.
*Strathmore Paper Co. (IP)
*Sweetwater Paper Board Co. (Caraustar)

T

Tagsons Papers Inc.
*Tahsis Pacific Region (CPFP/CIP)
Technographics Inc. (Rolland, Valentine)
Tembec Inc.
*Temple-Eastex (T-I)
*Temple-Inland Inc.
*Tennessee River Pulp & Paper Co. (PCA)
Texcrom Paper Corp.
Texon Inc.
*Thilmany Pulp & Paper (IP)
3M Co.
Tomahawk Power & Pulp Co.
Tomahawk Tissue Corp.
Toronto Paperboard Co.
*Trent Valley Paperboard (PIC)

U

*Union Camp Corp.
U.S. Packaging Inc.
U.S. Paper Mills Corp.
*United States Gypsum Co.
United States Paper Mills Inc. (Texcrom)

V

Valentine Pulp & Paper Co.
Vermont Tissue Paper Corp.
*Virginia Fibre Corp.

W

Ward Paper Co. (IP)
*Waldorf Corp.
*S.D. Warren (Scott)
Watervliet Paper Co. Inc.
*Wausau Paper Mills Co.
*Weldwood of Canada Ltd.
*Westar Timber Ltd. (Consolidated-Bathurst, Repap)
Westbrook Wood Products
*Western Pulp Limited Partnership
Westfield River Paper Co. Inc. (Simkins)
Weston Paper & Mfg. Co.
*Westvaco Corp.
*Weyerhaeuser Co.
*Weyerhaeuser Canada Ltd.
Whippany Paper Board Co. (Ponte)
White Pigeon Paper Co.
George A. Whiting Paper Co.
*Willamette Industries Inc.
Windsor Stevens Inc.
*Wisconsin Paperboard Corp. (Newark)
*Wisconsin Tissue Mills Inc. (Chesapeake)
Woodstream Corp.

Y

Yorktowne Paper Mills Inc.

MAJOR FIRMS
1,000-tpd capacity

A listing of U.S. and Canadian companies with daily production capacity of 1,000 short tons or more (U.S.) or 900 metric tpd (Canada), counting facilities for pulp, paper, and paperboard.

Abitibi-Price Inc.

The Exchange Tower, Suite 1300
2 First Canadian Place, Box 39
Toronto, Ont. M5X 1A9
Bernd K. Koken, chairman/president/chief executive officer

[Olympia & York Developments Ltd. had increased its ownership from 72.5% of Abitibi-Price to 74.8% by early 1988 and said it might increase its stake. Abitibi has two joint ventures: Gaspesia Pulp & Paper Co., subsidiary of Price, 51% (New York Times, 49%); and Augusta Newsprint Co., 50% (Thomson Newspapers Ltd., 50%).]

Net sales (C$):	
1987	$2,988,000,000
1986	2,763,500,000
1985	2,549,800,000
1984	2,137,200,000
Net earnings* (C$):	
1987	125,700,000
1986	110,100,000
1985	100,200,000
1984	72,300,000

*before extraordinary items

Abitibi-Price is the world's leading producer of newsprint and is important in uncoated and coated groundwood papers, with an annual capacity of 2.5 million metric tons (60% of total revenues). The company is emphasizing expansion into higher-value paper grades and paper distribution. About 90% of total sales result from pulp, paper, paperboard, and converting operations. Company forests provided 47% of wood fiber needs in 1986.

In 1986, Abitibi-Price sold its Smooth Rock Falls, Ont., market pulp mill to Waferboard Corp. Its core business is now basically newsprint (nine mills) and groundwood papers (two mills plus one machine producing 130,000 metric tpy), plus Provincial Papers, which makes 130,000 metric tpy of coated paper.

Early in 1988, Abitibi-Price and Parsons & Whittemore Inc. announced a tentative agreement to build jointly a 220,000-metric-tpy newsprint mill near P&W's Alabama River Pulp Co. bleached kraft market pulp mill at Claiborne, Ala. Abitibi would run the mill and market the output; P&W would be responsible for mill design and construction. If the plan proceeds as scheduled, the $320-million project could be completed by late 1990.

Sales of printing papers in 1987 were: newsprint, C$1,176 million; groundwood papers, $279 million; and coated papers, $168.8 million.

Newsprint capacity in 1988 was 1,938,000 metric tons; groundwood papers, 339,000 tons; and coated papers, 144,000 tons. Output of newsprint in 1987 was 1,833,000 tons; groundwood papers, 363,000 tons; and coated paper, 142,000 tons.

Capital expenditures were C$263 million in 1986 and $257 million in 1987. In 1986, $94 million was spent on newsprint operations and $122 million on groundwood paper projects. A $113-million plan for a three-year modernization and expansion of the Gaspesia mill at Chandler, Que., was announced in early 1987. The project included a new top former on No. 1 machine to improve quality and a capacity increase to 27,000 metric tpy. A $135-million project begun at Jonquière, Que., in 1985 and completed late in 1987 added clay-filled supercalendered capacity on two machines—about 45% of mill total capacity. The mill began selling SC-A in November 1987 and was expecting to upgrade the sheet to higher quality web-sized offset paper several months later.

Abitibi owns 1,047,680 acres of timberlands in Canada and controls another 22,102,400 acres; in the U.S., it owns 89,600 acres and controls 42,880 acres.

Production facilities:

PINE FALLS, MAN.
Pulp—136 metric tpd sulfite; 708 metric tpd groundwood
Newsprint—970 metric tpd

GRAND FALLS, NFLD.
(Price (Nfld.) Pulp & Paper)
Pulp—250 metric tpd sulfite; 800 metric tpd thermomechanical
Newsprint—485 metric tpd

STEPHENVILLE, NFLD.
(Stephenville Div.)
Pulp—600 metric tpd thermomechanical
Newsprint—475 metric tpd

GEORGETOWN, ONT.
(Provincial Papers, Port Arthur Div.)
Printing/writing papers—45 metric tpd

IROQUOIS FALLS, ONT.
Pulp—250 metric tpd sulfite; 760 tpd groundwood
Newsprint—825 metric tpd

THUNDER BAY, ONT.
(Provincial Papers)
Pulp—61 metric tpd groundwood
Printing/writing papers—318 metric tpd

THUNDER BAY, ONT.
(Fort William Div.)
Pulp—136 metric tpd sulfite (SCMP); 299 tpd groundwood
Newsprint—385 metric tpd

THUNDER BAY, ONT.
(Thunder Bay Div.)
Pulp—136 metric tpd sulfite; 408 tpd groundwood
Newsprint—400 metric tpd

ALMA, QUE.
(Price Co.)
Pulp—218 metric tpd sulfite; 708 tpd groundwood
Newsprint—550 metric tpd

BEAUPRE, QUE.
Pulp—550 metric tpd chemi-thermomechanical
Paper—381 metric tpd groundwood specialties

CHANDLER, QUE.
(Gaspesia Pulp & Paper Co.)
Pulp—408 metric tpd groundwood; 36 tpd refiner mechanical; 250 tpd bleached chemimechanical (BCMP)
Newsprint—617 metric tpd

JONQUIERE, QUE.
(Price/Kenogami Groundwood)
Pulp—299 metric tpd groundwood; 327 tpd chemi-thermomechanical
Paper—720 metric tpd groundwood specialties

LaCHUTE, QUE.
(Price Wilson)
Packaging, toweling paper—21 metric tpd

AUGUSTA, GA.
(Augusta Newsprint Co.)
Pulp—496 short tpd (450 metric) groundwood; 772 short tpd (700 metric) thermomechanical
Newsprint—1,075 short tpd (975 metric)

Total production capacity:

PULP	
Groundwood	3,801 metric tpd
SCMP	136 metric tpd
BCMP	250 metric tpd
Refiner mechanical	36 metric tpd
Sulfite	990 metric tpd
CTMP	877 metric tpd
TMP	2,100 metric tpd
Total	8,190 metric tpd
PAPER	
Newsprint	5,682 metric tpd
Groundwood	1,101 metric tpd
Printing/writing	363 metric tpd
Packaging/wrapping	21 metric tpd
Total	7,167 metric tpd

Appleton Papers Inc.

825 E. Wisconsin Ave.
Box 359
Appleton, Wis. 54912
John W. Turner, chairman/chief executive officer

(Subsidiary and paper division of BATUS Inc. of U.S., in turn a subsidiary of B.A.T. Industries plc of U.K.)

Net sales:	
1987	$779,000,000
1986	723,211,000
1985	639,139,000
1984	572,712,000
Operating income:	
1987	126,000,000
1986	134,342,000
1985	112,144,000
1984	105,358,000

Appleton is the world's largest producer of carbonless copy paper. It also produces thermal-grade paper, high-quality graphic arts products, and specialties. The company has converting/coating/finishing plants, capsular plants, and a chemical plant. Appleton is planning a multimillion-dollar thermal paper coating machine for its Appleton, Wis., finishing plant, backing up its commitment to thermal papers.

Sales by the paper segment were $779 million in 1987, and operating profit was $126 million.

In West Carrollton, Ohio, capital expenditures of $39.6 million included a two-roll calender in 1986. In 1987, No. 3 paper machine was converted to coated carbonless paper from basestock ($22 million), and in 1988, No. 1 machine will be rebuilt to achieve more speed and 15,000 tpy of carbonless capacity ($1.3 million). The Roaring Spring, Pa., mill added 5,000 tpy of carbonless capacity in the rebuild of Nos. 1 ($3.5 million) and 2 ($1.1 million) machines. Combined Locks, Wis., will add 14,000 tpy of capacity in 1988 in an off-machine rebuild ($6 million), and 4,000 tpy carbonless and basestock capacity in 1989 in the rebuild of No. 3 machine ($7.5 million).

Production facilities:

WEST CARROLLTON, OHIO
(West Carrollton Mill)
Pulp—180 tpd bleached deinked
Carbonless paper—350 tpd

ROARING SPRING, PA.
(Spring Mill)
Pulp—200 tpd bleached kraft
Carbonless paper—210 tpd

COMBINED LOCKS, WIS.
(Locks Mill)
Pulp—200 tpd chemimechanical
Carbonless paper—500 tpd

Total production capacity:

PULP	
Kraft	200 tpd
Chemimechanical	200 tpd
Deinked	180 tpd
Total	580 tpd
PAPER	1,060 tpd

Boise Cascade Corp.

One Jefferson Sq.
Boise, Idaho 83728
John B. Fery, chairman/chief executive officer

(Boise owns Boise Cascade Canada.)

Net sales:	
1987	$3,820,810,000
1986	3,739,970,000
1985	3,737,220,000
1984	3,816,850,000
Net income:	
1987	182,990,000
1986	101,540,000
1985	104,290,000
1984	69,610,000

After a restructuring program that began in 1980, Boise Cascade is concentrating on its paper, corrugated container, office products distribution, and building products businesses. It sold its Consumer Packaging Div. (composite cans) to Sonoco Products Co. in late 1986. Early in 1988, it announced it would close the Brownville, N.Y., specialty paperboard mill.

Operating income for paper and paper products was $326 million in 1987 (on 3.3 million tons) up from $197 million in 1986 (on 3 million tons). Total paper and paper product sales in 1987 were $2.156 million.

In 1986, Boise bought Allied Paper Co.'s Jackson, Ala., mill. It has the option of adding a second paper machine and integrating some of the market pulp now produced. In spring 1988, the company announced it would close the Brownville, N.Y., mill later in the year.

BC has spent $3.5 billion in the last 10 years to expand capacity, particularly of paper, and to improve quality. By 1986, 75% of total revenues came from paper, packaging, and office products operations.

Boise spent $287 million in 1986 on capital projects, including $161 million for the Jackson acquisition. Expenditures in 1987 were $259 million, of which $187 million went for paper projects.

Major projects were undertaken at Wallula, Wash.; DeRidder, Ala.; and Rumford, Maine. Among upgrades, the Kenora, Ont., mill will increase capacity 40,000 tpy in 1988 when a C$166-million project is completed. Mills at Fort Francis, Ont., and Vancouver and Steilacoom, Wash., were also targeted for upgrading. Boise may add an uncoated free-sheet machine at one of four mills, or a coated paper machine at Rumford, Maine. In June 1988, Boise announced it would build a new uncoated free-sheet machine and rebuild the pulp mill at International Falls, Minn.

Boise owns in fee 3.1 million acres of timberland and controls about 3.5 million more through long-term leases, contracts, and licenses.

Production facilities:

White Paper Div.

JACKSON, ALA.
(Former Allied Paper Co. mill)
Pulp—600 tpd bleached kraft (365 for market)
Uncoated free-sheet—270 tpd

INTERNATIONAL FALLS, MINN.
Pulp—400 tpd bleached kraft
Uncoated free-sheet—600 tpd

ST. HELENS, ORE.
Pulp—1,000 tpd bleached kraft
Uncoated free-sheet—630 tpd

VANCOUVER, WASH.
Uncoated free-sheet—285 tpd

WALLULA, WASH.
Pulp—765 tpd bleached kraft (325 tpd for market); 165 tpd semichemical
Uncoated free-sheet—530 tpd
Containerboard—300 tpd

Coated & Specialty Converting Paper Div.

RUMFORD, MAINE
Pulp—950 tpd bleached kraft; 180 tpd groundwood; 120 tpd thermomechanical
Coated paper—1,120 tpd
Uncoated free-sheet—285 tpd

Publishing & Packaging Paper

DeRIDDER, LA.
(Boise Southern Co.)
Pulp—1,095 tpd unbleached kraft, 180 tpd bleached kraft; 305 tpd groundwood; 415 tpd thermomechanical
Newsprint—940 tpd
Containerboard—1,050 tpd

STEILACOOM, WASH.
Pulp—480 tpd thermomechanical
Newsprint—530 tpd

FORT FRANCES, ONT.
(Boise Cascade Canada)
Pulp—455 metric tpd (550 short) groundwood; 510 metric tpd (560 short) bleached kraft (340 tpd for market)
Uncoated groundwood papers—680 metric tpd (750 short)

KENORA, ONT.
(Boise Cascade Canada)
Pulp—520 metric tpd (575 short) groundwood; 220 metric tpd (245 short) sulfite
Newsprint—760 metric tpd (840 short)

Specialty Paperboard Div.

BEAVER FALLS, N.Y.
(Two mills)
Pulp—100 tpd refiner mechanical
Specialty paperboard—85 tpd

BROWNVILLE, N.Y.
(Mill will close in late 1988)
Specialty paperboard—75 tpd

BRATTLEBORO, VT.
Specialty paperboard—75 tpd

SHELDON SPRINGS, VT.
Pulp—55 tpd groundwood
Specialty paperboard—145 tpd

Total production capacity:

PULP (short tons)	
Kraft	5,550 tpd
Groundwood	1,665 tpd
TMP	1,015 tpd
Refiner mechanical	100 tpd
Sulfite	245 tpd
Semichemical	165 tpd
Total	8,740 tpd

PAPER & BOARD (short tons)	
Uncoated free-sheet	2,600 tpd
Newsprint	2,310 tpd
Coated	1,120 tpd
Uncoated groundwood	750 tpd
Containerboard	1,350 tpd
Specialty paperboard	380 tpd
Total	8,510 tpd

Bowater Inc.

1 Parklands Drive, Box 4012
Darien, Conn. 06820-4012
A.P. Gammie, chairman/president/chief executive officer

[Bowater owns 51% of Catawba Newsprint Co. (Newhouse Newspaper Group, 49%) and 51% of Mersey Paper Co. Ltd. (*The Washington Post*, 49%).]

Net sales:	
1987	$1,231,002,000
1986	919,690,000
1985	904,004,000
1984	887,855,000
Net income:	
1987	81,140,000
1986	49,444,000
1985	67,520,000
1984	72,098,000

Spun off by its English parent as an independent company in 1984, Bowater is a major, efficient producer of newsprint (about 75% of its capacity), coated publication paper, and market pulp. It is the largest U.S. manufacturer of newsprint, and the third largest in North America. Bowater has been diversifying into the forms business and in 1986 doubled this division through the acquisition of Star Forms Inc. The company sold off its older Cornerbrook, Nfld., newsprint mill to Kruger Inc. in 1984.

Newsprint output in 1987 was 1,247,000 short tons, and sales totaled $607.1 million. Coated paper output and sales were 312,000 tons and $203.7 million, respectively; pulp output and sales were 254,000 tons and $125.1 million, respectively.

Capital expenditures by sector in 1987: newsprint, $48.09 million; coated paper, $12.48 million; pulp, $3.21 million.

In late 1987, Bowater Mersey announced it would expand and upgrade its 250,000-metric-tpy newsprint mill at Liverpool (Brooklyn), N.S., by 50,000 tpy of newsprint capacity and convert the mill to 100% thermomechanical pulp. The C$128-million project will be completed by late 1989.

A project at Catawba Newsprint's mill will raise capacity to 10,000 tpy by late 1988.

In spring 1988, Bowater Southern announced a $205 million, 320,000-tpy bleached kraft pulp mill to replace the existing mill at Calhoun, Tenn. The new installation will supply the newsprint machines with higher-quality pulp in addition to producing 80,000 tpy market pulp; it should start up in 1990.

Bowater owns or leases 1.8 million acres of timber.

Production facilities:

CATAWBA, S.C.
(Bowater Carolina Co.)
Pulp—1,050 tpd bleached kraft (700 tpd for market); 120 tpd thermomechanical; 90 tpd groundwood
Coated publication paper—365 tpd

CATAWBA, S.C.
(Catawba Newsprint Co.)
Pulp—544 tpd thermomechanical
Newsprint—680 tpd

CALHOUN, TENN.
(Bowater Southern Paper Co.)
Pulp—690 tpd semibleached kraft; 900 tpd groundwood; 220 tpd chemimechanical; 1,000 tpd thermomechanical
Newsprint—2,150 tpd

LIVERPOOL (Brooklyn), N.S.
(Bowater Mersey Paper Co.)
Pulp—345 metric tpd (380 short) groundwood; 181 metric tpd (200 short) thermomechanical; 163 metric tpd (180 short) sulfite
Newsprint—608 metric tpd (670 short)

Total production capacity:

PULP (short tons)	
Chemimechanical	220 tpd
Kraft	1,740 tpd
Groundwood	1,370 tpd
Sulfite	180 tpd
TMP	1,864 tpd
Total	5,374 tpd

PAPER (short tons)	
Publication	365 tpd
Newsprint	3,500 tpd
Total	3,865 tpd

Brant-Allen Industries Inc.

(Formerly Bato Co. Inc.)
80 Field Point Road
Greenwich, Conn. 06830
Peter M. Brant, chief executive officer

(F.F. Soucy Inc. is a wholly owned subsidiary. Brant-Allen owns 50% of F.F. Soucy Inc. et Associés, Dow Jones 40%, and Rexfor 10%. Brant-Allen is joint owner of Bear Island Paper, with Dow Jones and *Washington Post*.)

Financial data not available.

Brant-Allen, an integrated manufacturer, produced 402,000 short tons of newsprint in 1986.

Capital expenditures in 1986 were $10 million, and $11 million was budgeted for 1987. This does not include a possible 200,000-metric tpy newsprint machine being considered for Bear Island. Soucy is raising groundwood paper capacity by 20,000 tpy in a C$35-million rebuild of No. 2 machine, for spring 1988 completion.

The rebuild of No. 2 newsprint and groundwood papers machine at F.F. Soucy et Associés' mill at Rivière-du-Loup, Que., for completion at end-1988 at a cost of C$57.3 million, will add 20,000 metric tpy capacity. Replacement of the fourdrinier on No. 1 newsprint machine will add 4,000 tpy; this $3-million project will be completed by fall 1989.

Brant-Allen owns 75,000 acres of timberlands in U.S.

Production facilities:

ASHLAND, VA.
(Bear Island Paper Co.)
Pulp—625 tpd thermomechanical
Newsprint—580 tpd

RIVIERE-du-LOUP, QUE.
(F.F. Soucy Inc.)
Pulp—490 metric tpd (540 short) thermomechanical
Newsprint—151 metric tpd (166 short)

RIVIERE-du-LOUP, QUE.
(F.F. Soucy Inc. et Associés)
Newsprint—364 metric tpd (401 short)

Total production capacity:

PULP (short tons)	
TMP	1,165 tpd
PAPER (short tons)	
Newsprint	1,147 tpd

British Columbia Forest Products Ltd.

1050 W. Pender St.
Vancouver, B.C. V6E 2X3
Ian Donald, president/chief executive officer

[Fletcher Challenge Ltd. of New Zealand holds a 69% interest in BCFP and 100% of Crown Forest Ltd. These two major British Columbia forest products companies were recently brought together under a new management structure to be called Fletcher Challenge Canada Ltd. The combination of the two companies is expected to result in significant savings in production, marketing, and transportation. The New Zealand company began acquiring its stake in BCFP in early 1987 after Alberta Energy Co. Ltd., Brunswick Pulp & Paper Co., and Mead Corp. sold their interests the previous year amounting to 47% of the company.

[BCFP owns Blandin Paper Co. in U.S.; 45% of Donohue St-Félicien Inc.; 50% of Finlay Forest Products Industries Ltd. (balance held by Cattermole Timber Ltd. and Jujo Paper Co. Ltd.); and 20.7% of Western Forest Products Ltd., parent of Western Pulp Limited Partnership (Whonnock Industries Ltd. and Doman Industries Ltd. similar interests).]

Net sales (C$):	
1987	$1,400,427,000
1986	1,100,950,000
1985	1,139,963,000
1984	1,014,726,000
Net earnings (C$):	
1987	140,232,000
1986	40,232,000
1985	30,085,000
1984	9,190,000

BCFP is an integrated forest products company that concentrates on market pulp, newsprint, and coated grades. The company is also one of Canada's largest lumber producers. About 63% of total sales was contributed by pulp and paper operations. Once one of the most rapidly expanding and efficient of Canadian forest products companies, BCFP was hard hit by weak market conditions for its main product lines in the first half of the 1980s. The company, however, is now on the rebound, helped by its relatively modern low-cost mills and strong newsprint and pulp markets. One problem, however, is the 15% tax imposed by the Canadian government in late 1986 on lumber exported to the U.S.

Blandin's output of lightweight coated papers was 286,000 short tons in 1987. Market pulp production reached 449,000 metric tons and newsprint 447,000 metric tons. Associate company output: Donohue St-Félicien, 281,000 metric tons of pulp; and Finlay Forest Industries, 131,000 metric tons of pulp.

Total capital expenditures for 1987 were C$81.1 million, up from $37.9 million in 1986. In mid-1987 Finlay announced that it would build the planned 216,000-metric-tpy newsprint mill as part of a C$212-million project at Mackenzie, B.C. The machine, the first in the British Columbia interior, will integrate Finlay and remove the mill's pulp output from the market. Startup target date is spring 1989. A $32-million expansion project at Crofton, B.C., will raise chemi-thermomechanical capacity to 555 metric tpd from 320 tpd by fall 1988 and supply all of the fiber required by newsprint production. An additional C$238-million upgrade will reduce production costs and increase kraft pulp output by 45,000 metric tpy to 385,000 tpy at this mill. Completion is set for 1991. In a $344-million project, a 254,000-short-tpy lightweight coated groundwood paper machine will be built at the Grand Rapids, Mich., mill of Blandin Paper. December 1989 is the target date for start up of the project, which will include a new woodroom and upgrading of the groundwood pulp mill. A 37,000-tpy machine will be shut down.

BCFP's timber sources include ownership of 131,000 acres in U.S. and 222,000 acres in Canada and cutting rights on 1,139,000 acres in Canada.

Production facilities:

CROFTON, B.C.
(Crofton Pulp & Paper Div.)
Pulp—1,000 metric tpd kraft (750 tpd for market); 940 metric tpd mechanical
Newsprint and specialty paper—1,300 metric tpd

MACKENZIE, B.C.
(Mackenzie Div.)
Pulp—580 metric tpd kraft (for market)

MACKENZIE, B.C.
(Finlay Forest Products Ltd.)
Pulp—450 metric tpd groundwood (BCFP's share: 225 tpd)
Newsprint (proposed)—605 metric tpd

ST-FELICIEN, QUE.
(Donohue St-Félicien Inc.)
Pulp—850 metric tpd bleached kraft (BCFP's share: 396 tpd)

GRAND RAPIDS, MINN.
(Blandin Paper Co.)
Pulp—330 short tpd (299 metric) mechanical
Coated groundwood—820 short tpd (744 metric)

Total production capacity:

PULP	
Kraft	1,976 metric tpd
Mechanical	1,239 metric tpd
Groundwood	225 metric tpd
Total	3,440 metric tpd

PAPER	
Newsprint*	1,300 metric tpd
Coated groundwood	744 metric tpd
Total	2,044 metric tpd

*does not include proposed mill

Canadian Pacific Forest Products Ltd.

Cecil S. Flenniken, chairman/president/
chief executive officer

In April 1988, Canadian Pacific Ltd., which owned CIP Inc. and 54.3% of Great Lakes Forest Products, announced that it would merge the two into a new company. GLFP will issue 24.4 million common shares to CP in exchange for all of the shares of CIP. This would give CP 79.7% of Canadian Pacific Forest Products Ltd. The plan was approved at the June 2, 1988, annual meeting of GLFP, with implementation expected to proceed without delay.

The new company becomes the second largest market pulp and newsprint producer in North America, with newsprint capacity of 1.5 million metric tpy and market pulp capacity of 925,000 tpy, and both components have expansions underway.

The profiles for CIP and GLFP are pre-merger.

CIP Inc.
1155 Metcalfe St.
Montreal, Que. H3B 2X1
C.S. Flenniken, president/chief
executive officer

(Canadian Pacific Ltd. owns CIP, and it also owns 54.3% of Great Lakes Forest Products. Japanese firms Oji Paper Co. and Mitsui & Co. Ltd. hold 25% and 8% of NBIP Ltd., respectively. CIP owns 70% of Gold River Newsprint Ltd. Partnership; the balance is held equally by seven partners located in U.S., Japan, and U.K.)

Net sales (C$):	
1987	$1,934,000,000
1986	1,602,043,000
1985	1,569,811,000
1984	1,594,621,000
Net earnings (C$):	
1987	117,800,000
1986	12,863,000
1985	−16,635,000
1984	−13,820,000

Canadian Pacific acquired CIP from International Paper Co. in 1981 for C$1.1 billion, but the acquisition soon proved to be a heavy financial burden for the new parent. Subsequent losses reflected weak market conditions, heavy debt load, and older, higher-cost mills. But substantial investment in modernization and restructuring is beginning to pay off in increased competitiveness.

In fall 1987, the company announced plans to proceed with the 225,000 metric-tpy greenfield newsprint mill project adjacent to its Gold River, B.C., market pulp mill. Site clearing started in September 1987, with fall 1989 set as the startup date. Early in 1988, CIP announced the formation of Gold River Newsprint Ltd. Partnership to own and operate the mill, with CIP being the major stockholder (70%), along with five western U.S. publishers, a British newspaper publisher, and a Japanese trading company.

CIP also makes tissue, packaging, and lumber and building products.

In 1987, the company spent C$119.7 million on mill modernization, down from $131.7 million in 1986. Major projects include a new 155,000-metric-tpy newsprint machine for the Gatineau, Que., mill for startup in late 1987 (replacing an existing machine) and the upgrading of its Trois Rivières, Que., mill to produce higher value-added groundwood specialties.

CIP has run trials of newsprint made from kenaf pulp and may invest in a 250,000 tpy kenaf newsprint mill (Kenaf International Inc.) proposed for southern Texas for 1990-91.

Production facilities:

GOLD RIVER, B.C.
(Gold River Newsprint Ltd. Partnership)
Pulp—750 metric tpd kraft (for market)

DALHOUSIE, N.B.
(NBIP Ltd.)
Pulp—570 metric tpd stone groundwood; 410 metric tpd New Process (SCMP); 20 metric tpd high-yield sulfite
Newsprint—1,000 metric tpd
Mill wrappers—30 metric tpd

TORONTO, ONT.
(Dominion Cellulose Ltd.)
Tissue and towel—265 metric tpd

GATINEAU, QUE.
Pulp—550 metric tpd stone groundwood; 550 metric tpd refiner groundwood; 450 metric tpd chemimechanical
Newsprint—1,400 metric tpd

LA TUQUE, QUE.
Pulp—1,450 metric tpd kraft (460 tpd for market)
Kraft paperboard—700 metric tpd
Solid bleached board—280 metric tpd

MATANE, QUE.
Pulp—250 metric tpd semichemical
Semichemical corrugating medium—260 metric tpd

TROIS RIVIERES, QUE.
Pulp—240 metric tpd sulfite; 680 metric tpd groundwood
Groundwood specialties—900 metric tpd
Mill wrapper/core—60 metric tpd

Total production capacity:

PULP	
Kraft	2,200 metric tpd
Groundwood	2,350 metric tpd
New process (SCMP)	410 metric tpd
Chemimechanical	450 metric tpd
Semichemical	250 metric tpd
Sulfite	260 metric tpd
Total	5,920 metric tpd

PAPER & BOARD	
Newsprint	2,400 metric tpd
GWD specialties	900 metric tpd
Tissue/towel	265 metric tpd
Wrapper/core	60 metric tpd
Unbleached board	700 metric tpd
Solid bleached board	280 metric tpd
Corrugating medium	260 metric tpd
Total	4,865 metric tpd

Great Lakes Forest Products Ltd.
Box 430
Thunder Bay, Ont. P7C 4W3
Charles J. Carter, chairman/president

(Canadian Pacific Ltd. owns 54.3% of Great Lakes Forest Products Ltd.)

Net sales (C$):	
1987	$752,221,000
1986	637,531,000
1985	592,110,000
1984	601,976,000
Net income (C$):	
1987	96,185,000
1986	30,049,000
1985	216,000
1984	17,779,000

Great Lakes is a major producer of bleached kraft market pulp and newsprint and has been expanding production of uncoated free-sheet. It also produces lumber and waferboard. The company saw its return on investment decline in the first half of the 1980s, mainly related to poor market conditions for pulp and newsprint, particularly in its key midwestern U.S. marketing area. The company also had to make heavy investments in the Dryden, Ont., mill acquired in 1979. Another factor was a large loss on foreign exchange trading taken in the 1982-84 period. Profitability, however, has recently been on the upswing.

Net sales of pulp and paper were $724.9 million in 1987, up from $601.2 million in 1986. Operating profit was

$236.1 million in 1987, up from $128.6 million in 1986.

Shipments in 1987 included 587,000 metric tons of kraft pulp (571,000 tons in 1986), 381,000 metric tons of newsprint (361,000), and 101,000 metric tons of fine papers (100,000).

Capital expenditures in 1987 were $352.4 million, up from $30.7 million in 1986. In spring 1987, a C$400-million, five-year program was announced to add a new, 175,000-metric-tpy white paper machine at Dryden, Ont., and a 240,000-metric-tpy newsprint machine at Thunder Bay, Ont. The Dryden machine is scheduled to start in the latter half of 1989 and will make total capacity 285,000 metric tpy. The Thunder Bay machine, for 1991 startup, will have capacity for 240,000 metric tons of newsprint, an incremental increase of 60,000 tons over the two machines it is replacing. Great Lakes' Ponderay Newsprint Co. project in eastern Washington, at Usk, was given the green light in mid-1987, and ground was broken in October. Delays occurred when one of the supporting publishers withdrew, but early in 1987 there was again a full complement of five publishers. The 154,000-tpy greenfield mill will cost about $300 million and may come onstream by late 1989. The project is a joint venture between the publishers and a GLFP subsidiary, Lake Superior Forest Products Inc., which has a 40% stake.

Great Lakes holds timber harvesting rights on 66.3 million acres of woodlands in Canada.

Production facilities:

DRYDEN, ONT.
Pulp—720 metric tpd kraft, bleached and unbleached (360 tpd for market)
Fine paper—350 metric tpd

THUNDER BAY, ONT.
Pulp—1,195 metric tpd bleached kraft (for market); 295 tpd high-yield sulfite; 910 tpd groundwood
Newsprint—1,110 metric tpd

USK, WASH.
(Greenfield mill, 1988-89 startup)
Newsprint—475 short tpd (430 metric)

Total production capacity:

PULP	
Kraft	1,915 metric tpd
Sulfite	295 metric tpd
Groundwood	910 metric tpd
Total	3,120 metric tpd
PAPER	
Fine paper	350 metric tpd
Newsprint*	1,110 metric tpd
Total*	1,460 metric tpd

*does not include Usk mill

Canfor Corp.

2800—1055 Dunsmuir St.
Box 49420, Bentall Postal Station
Vancouver, B.C. V7X 1B5
Peter J.G. Bentley, chairman/chief executive officer

(Canadian Forest Products Ltd., Prince George Pulp & Paper Ltd., and Intercontinental Pulp Co. are fully owned subsidiaries. Howe Sound Pulp & Paper Ltd. is 50% owned.)

Net sales (C$):	
1987	$1,244,900,000
1986	1,046,766,000
1985	1,083,799,000
1984	1,029,500,000
Net earnings (C$):	
1987	102,700,000
1986	23,785,000
1985	-61,454,000
1984	-23,800,000
Net sales, pulp & paper (C$):	
1986	320,000,000
1985	254,000,000
1984	262,000,000

Canfor is one of Canada's largest producers of market pulp and lumber. The company returned to profitability in 1986, after four years of heavy losses (totaling $213 million) due to weak markets. In 1985, it bought the shares of Intercontinental Pulp that it did not already own. The company sold interests in several wood products, financial, and diversified manufacturing companies to reduce debt.

The company went public in 1983 because of difficult economic conditions. About 54% of its stock is still owned by the founding Prentice and Bentley families.

In late 1987, Canfor and Oji Paper Co. Ltd. of Japan announced plans to establish a new company to acquire the Howe Sound Pulp Div. at Port Mellon, B.C., plus a sawmill and chipping plant. The new company, Howe Sound Pulp & Paper Ltd., is a 50-50 joint venture. Japanese investments will bring its capacity for market pulp to 1,000 metric tpd by 1990 and add a 535-metric-tpd newsprint machine by 1991.

Canfor pulp and paper sales reached C$480.7 million in 1987, 39% of total sales.

Canfor produced 631,000 metric tons of pulp in 1987, up from 515,800 tons in 1986. It also produced 103,600 metric tons of kraft paper, up from 101,100 tons in 1986.

Capital expenditures in 1987 were C$57.9 million, up from $37.9 million in 1986.

Canfor will spend C$30 million in 1988 to modernize its mills at Prince George, B.C.

Production facilities:

PORT MELLON, B.C.
(Howe Sound Pulp & Paper Ltd.; formerly Howe Sound Pulp Div.)
Pulp—670 metric tpd bleached kraft (for market)

PRINCE GEORGE, B.C.
(Intercontinental Pulp Div., Prince George Pulp & Paper)
Pulp—667 metric tpd bleached and unbleached kraft (for market)

PRINCE GEORGE, B.C.
(Prince George Pulp & Paper)
Pulp—790 metric tpd bleached and unbleached kraft (495 tpd for market)
Sack paper—295 metric tpd

Total production capacity:

PULP	2,127 metric tpd
PAPER	295 metric tpd

Caraustar Industries Inc.

Washington St., Box 115
Austell, Ga. 30001
James G. Dalton, chairman/chief executive officer

Financial data not available.

Caraustar is a holding company that has recycled paperboard mills and converting plants. It is the fourth-largest U.S. producer of recycled paperboard and has eight mills with a total capacity of about 500,000 tpy. It acquired the Sinking Spring, Pa., mill from Maryland Paper Box Co.

Settsu Corp., Japan's leading producer of recycled paperboard, bought a 21.5% minority interest in Caraustar early in 1987.

Production facilities:

AUSTELL, GA.
(Austell Box Board Corp.)
Recycled paperboard—425 tpd

AUSTELL, GA.
(Sweetwater Paper Board Co.)
Recycled paperboard—375 tpd

CHICAGO, ILL.
(Chicago Paperboard Corp.)
Recycled paperboard—200 tpd

CHARLOTTE, N.C.
(Carolina Paper Board Corp.)
Recycled paperboard—150 tpd

CINCINNATI, OHIO
(Cincinnati Paperboard Corp.)
Recycled paperboard—200 tpd

SINKING SPRING, PA
(Reading Paper Board Corp.)
Recycled paperboard—47 tpd

TAYLORS, S.C.
(Carotell Paper Board Corp.)
Recycled paperboard—185 tpd

CHATTANOOGA, TENN.
(Chattanooga Paperboard Corp.)
Recycled paperboard—150 tpd

Total production capacity:

PAPERBOARD	1,732 tpd

Cascades Inc.

404 Marie-Victorin St.
Box 30
Kingsey-Falls, Que. J0A 1B0
Bernard Lemaire, president

(Cascades has 50% ownership in Les Industries Cascades Ltée and Cascades (Port-Cartier) Inc. It increased its share in Papier Cascades (Cabano) Inc. to 95% when it bought 30% from Rexfor in spring 1987. Also in 1987, it tried to acquire Rolland Inc., buying 34% of voting and 28.7% of nonvoting shares. Early in 1988, it acquired Reid Dominion Packaging Ltd.)

Net sales (C$)	
1987	$527,732,000
1986	440,130,000
1985	266,272,000
1984	179,651,000
Net earnings (C$)	
1987	34,148,000
1986	33,777,000
1985	19,443,000
1984	12,667,000

Founded in 1964, Cascades has grown rapidly through a series of acquisitions in eastern Canada, the U.S. and France. The company is controlled by the entrepreneurial Lemaire family of Quebec, which originally started in the wastepaper business. The company's secret of success has been to buy older mills for low prices (often with government assistance) in the segment the company knows best (wastepaper-based) and then try to involve employees in decision-making.

The company's product line has grown to include pulp and kraft paper, toilet paper and paper towels, corrugating medium, boxboard, egg trays, roofing insulating paper, health and hygiene products, and plastics. It now has a total of 11 mills in North America plus three recycled boxboard mills recently acquired in France. At the end of 1987, it increased its involvement in France as part of a joint venture to bail out Remap Chapelle Darblay, which has newsprint and lightweight coated paper mills. Cascades withdrew from this new venture in mid-1988 after disagreements with a French partner.

Paper sector (pulp, paper, paperboard) sales in 1987 were C$460 million, up from $380 million in 1986, and operating income was $41.6 million ($38 million in 1985). Cascades spent C$54.4 million on paper sector capital expenditures in 1987, up from $28.4 million in 1986. It announced a plan in spring 1987 to spend C$30 million over two years to upgrade the Jonquière, Que., mill. Paperboard output will be increased to 250 tpd and the mill will use more of its pulp, reducing the quantity sold to 120 tpd.

In a joint venture, Rexfor and Cascades acquired the closed Port-Cartier, Que., mill from ITT Rayonier Inc. in 1986. With the help of government funds, the mill was converted to bleached chemi-thermomechanical from sulfite pulp. Trial CTMP was made late in December 1987, with full production to start in 1988. With the startup of the bleaching line in 1988, the mill will produce BCTMP. In spring 1988, the operators were considering adding a newsprint machine for startup about 1992.

Cascades bought printing/writing and tissue machines and equipment in the bankrupt Nitec Paper Corp. mill in Niagara Falls, N.Y., from Repap Enterprises Corp. in early 1986. After long negotiations, it purchased the buildings and land from the city. In January 1988, No. 1 machine began producing recycled newsprint. But now both No. 1 and No. 2 machines are producing recycled corrugating medium. Both units have rated capacity of about 30,000 to 35,000 short tpy. One machine at the mill was sold in 1986, and there were no final plans on the future of the fourth machine.

Production facilities:

BRANTFORD, ONT.
(Cascades Dominion Inc., former Reid Dominion Packaging Ltd. mill)
Molded pulp products—egg cartons

BREAKEYVILLE, QUE.
(Désencrage Cascades Inc.)
Pulp—91 metric tpd deinked (for market)

CABANO, QUE.
(Papier Cascades [Cabano] Inc.)
Pulp—250 metric tpd semichemical
Corrugating medium—272 metric tpd

EAST ANGUS, QUE.
(Cascades [East-Angus] Inc.)
Pulp—181 metric tpd unbleached kraft; 109 metric tpd semichemical
Kraft wrapping paper—240 metric tpd
Folding boxboard—100 metric tpd

JOLIETTE, QUE.
(Cascades [Joliette] Inc.)
Sheathing, indenting paper—64 metric tpd

JONQUIERE, QUE.
(Cascades (Jonquière) Inc.)
Pulp—200 metric tpd bleached and unbleached kraft (60 tpd for market); 100 metric tpd thermomechanical
Boxboard—190 metric tpd

KINGSEY FALLS, QUE.
(Cascades Paper Inc.)
Corrugating medium—77 metric tpd
Molded pulp products—29 metric tpd

KINGSEY-FALLS, QUE.
(Les Industries Cascades Ltée.)
Tissue—50 metric tpd
Toweling—77 metric tpd

KINGSEY-FALLS, QUE.
(Papier Kingsey-Falls)
Asbestos paper—118 metric tpd

PORT-CARTIER, QUE.
(Cascades [Port-Cartier] Inc.)
Pulp—500 metric tpd bleached chemi-thermomechanical

NIAGARA FALLS, N.Y.
(Cascades Niagara Falls Inc.—former Nitec Paper Corp. mill)
Corrugating medium—200 short tpd (181 metric)

ROCKINGHAM, N.C.
(Cascades Industries Inc.)
Tissue—60 short tpd (54 metric)

Total production capacity:

PULP	
Kraft	381 metric tpd
Semichemical	359 metric tpd
TMP, BCTMP	600 metric tpd
Deinked	91 metric tpd
Total	1,431 metric tpd

PAPER & BOARD	
Tissue/toweling	181 metric tpd
Kraft packaging	240 metric tpd
Corrugating medium	530 metric tpd
Boxboard	280 metric tpd
Industrial paper/board	182 metric tpd
Total	1,413 metric tpd

Champion International Corp.

One Champion Plaza
Stamford, Conn. 06921
Andrew C. Sigler, chairman/chief executive officer

(Champion owns 84.6% of Weldwood of Canada Ltd., which in turn owns 50% of Cariboo Pulp & Paper Co.; Daishowa-Marubeni International Ltd. owns the other 50%.)

Net sales:	
1987	$4,614,723,000
1986	4,387,623,000
1985	5,769,759,000
1984	5,121,089,000
Net income:	
1987*	382,012,000
1986	200,832,000
1985*	163,139,000
1984*	139,032,000

*1987 includes $88.7-million net gain from sale of assets.
1985 excludes $5-million gain from St. Regis acquisition.
1984 net excludes after-tax write-off of $150 million for restructure of building products plants and timber contract expected losses. Excludes 60% of St. Regis for October and November and 100% for December.

Champion International is emphasizing growth in the printing/writing grades following the sale of all but one of its unbleached kraft packaging mills. Its merger with St. Regis Paper Co. focused Champion on being primarily a pulp and paper company and combined Champion's strength in coated and uncoated free sheet grades with St. Regis' strength in uncoated groundwood grades, lightweight coated publication papers, and newsprint.

Since the merger, however, a number of mills have been sold: Battle Creek, Mich., and St. Paul, Minn., to Waldorf Corp.; Ontonagon, Mich., Missoula, Mont., and York, Pa., to Stone Container Corp.; Pasadena, Texas, and Tacoma, Wash., to Simpson Paper Co.; and Little Falls, Minn., to Carlyle Investment Corp.

In early 1988, Weldwood of Canada Ltd. got approval from shareholders to purchase Champion's St. Regis Paper Co. (Canada) Ltd., which includes Champion Forest Products (Alberta) Ltd. (of which the Hinton, Alta., market pulp mill is a part) and St. Regis Resources Ltd. (oil and gas). In exchange, Champion's share in Weldwood was boosted from 71.8% to 84.6%.

In spring 1988, Champion was negotiating sale of the Columbus, Ohio, mill to Du Pont Co.'s Industrial Imaging Systems Div.

Net sales from the paper division in 1987 were $3.4 billion and constituted 74% of total sales. Printing/writing papers accounted for 47% of paper sales; lightweight publication papers, 18%; and newsprint, 11%.

Champion's paper division produced 3,415,091 tons of paper and board in 1987, and Weldwood of Canada 356,152 short tons. Champion's output of pulp was 3,246,977 tons, and Weldwood's output was 149,578 tons. U.S. packaging operations produced 437,800 tons of paper and paperboard and 416,000 tons of pulp.

Output of coated paper in 1987 was 302,000 tons, down from 378,000 tons in 1986; uncoated paper, 1,021,000 (1,003,000); publication paper, 625,000 (633,000); and newsprint, 834,000 (801,000).

Champion expects to spend an average $425 to $450 million per year over the next few years on capital investments. The figure for 1987 was $365 million, and about $550 million is budgeted for 1988.

Early in 1989, the company announced that it would go ahead with construction of a 165,000-tpy coated free-sheet paper machine at Quinnesec, Mich. About half the mill's pulp output will be used by the machine. Startup is likely in late 1990.

In a major grade switch, No. 5 machine at Pensacola, Fla., was changed in 1986 from unbleached kraft paper (Stress Kraft) to uncoated free-sheet. Some of the loss in kraft paper was made up by the addition of capacity at Roanoke Rapids, N.C., in a No. 3 machine rebuild. No. 4 machine at this mill will have a $16-million upgrade which will lift linerboard capacity to 800 tpy by October 1988. At Pensacola, No. 3 machine's capacity will be raised from 98,000 tpy to 125,000 tpy in a project to be completed in 1988.

At Bucksport, Maine, Champion will rebuild No. 4 machine, which makes coating basestock, converting it to make coated paper. The $100-million project is scheduled for completion about 1990.

A major upgrade of about $150 to $200 million over three years to meet environmental regulations will keep the Canton, N.C., mill operating.

Champion owns or controls 6,474,000 acres of timberland in the U.S. In Canada, the company has cutting rights on 1,906,000 acres in Alberta, and Weldwood owns 42,000 acres and holds a pulpwood harvesting license on 3.9 million acres.

Production facilities:

COURTLAND, ALA.
(Paper Div.)
Pulp—1,300 tpd kraft (275 tpd for market)
Uncoated and coated printing/writing and converting paper—1,645 tpd

PENSACOLA (Cantonment), FLA.
(Printing & Writing Div.)
Pulp—1,050 tpd unbleached kraft; 285 tpd bleached kraft
Uncoated free-sheet paper—750 tpd
Kraft paper—350 tpd

BUCKSPORT, MAINE
(Printing Paper Div.)
Pulp—300 tpd groundwood; 150 tpd thermomechanical
Printing/writing paper—1,120 tpd

QUINNESEC, MICH.
Pulp—750 bleached hardwood kraft (for market)

SARTELL, MINN.
(Publication Paper Div.)
Pulp—400 tpd thermomechanical
Printing/writing paper—760 tpd (510 tpd coated, 250 tpd uncoated)

DEFERIET, N.Y.
(Publication Paper Div.)
Pulp—320 tpd groundwood
Coated and uncoated printing/writing paper—630 tpd

CANTON, N.C.
(Paper Div.)
Pulp—1,440 tpd bleached kraft
Uncoated printing/writing and converting paper—970 tpd
Bleached paperboard—655 tpd

ROANOKE RAPIDS, N.C.
(Packaging Div.)
Pulp—1,300 tpd unbleached kraft
Unbleached kraft paper—525 tpd
Unbleached linerboard—650 tpd

COLUMBUS, OHIO
(Printing Paper Div.)
Specialty packaging paper—50 tpd

HAMILTON, OHIO
(Paper Div.)
Uncoated and coated printing/writing and converting paper—540 tpd

HOUSTON, TEXAS
(Newsprint Div., Sheldon Mill)
Pulp—650 tpd kraft (unbleached 300 tpd, bleached 350 tpd); 800 tpd groundwood; 400 tpd thermomechanical
Newsprint—1,220 tpd

LUFKIN, TEXAS
(Newsprint Div., Lufkin Mill)
Pulp—400 tpd unbleached kraft (360 tpd semibleached); 830 tpd groundwood
Newsprint—980 tpd
Directory paper—125 tpd

QUESNEL, B.C.
(Cariboo Pulp & Paper Co.—See Daishowa America Co. and Weldwood of Canada Ltd.)

Total production capacity:

PULP (short tons)	
Kraft	7,175 tpd
Groundwood	2,250 tpd
TMP	950 tpd
Total	10,375 tpd

PAPER (short tons)	
Newsprint	2,220 tpd
Printing/writing	5,665 tpd
Uncoated free-sheet	750 tpd
Directory	125 tpd
Kraft, packaging	925 tpd
Total	9,665 tpd

PAPERBOARD (short tons)	
Bleached	655 tpd
Linerboard	650 tpd
Total	1,305 tpd
TOTAL PAPER/BOARD	10,970 tpd

Chesapeake Corp.

Box 311
West Point, Va 23181
J Carter Fox, president/chief executive officer

Net sales	
1987	$675,713,000
1986	599,770,000
1985	449,500,000
1984	347,700,000
Net income	
1987	30,153,000
1986	13,738,000
1985	15,694,000
1984	22,133,000

From only one mill at West Point, Va., Chesapeake underwent a dramatic change in 1985 with its $210 million purchase of Wisconsin Tissue Mills Inc and Plainwell Paper Co. from Philip Morris Inc. This extended its original product line of linerboard, kraft paper, and hardwood market pulp to include commercial/industrial tissue and coated and uncoated specialty and premium printing papers. However, in late 1987, Chesapeake sold Plainwell to Simpson Paper Co., eliminating printing and special industrial papers from its line.

The company undertook a major $120-million expansion program at its West Point, Va., mill, which included installation of a multi-ply machine to make linerboard and conversion of an existing linerboard machine to production of recycled medium (another new product for the company). Ramp up of the new No. 3 linerboard machine to its initial target capacity of 900 tpd has been difficult. The machine will have the flexibility to produce mottled white and white-top linerboard (the latter a new grade for the U.S.), which can be preprinted and used in point-of-purchase display packaging.

In selling Plainwell, Chesapeake decided to concentrate on expanding its Wisconsin Tissue operation. An 80,000-tpy tissue machine will be added at Menasha, Wis., raising mill capacity to about 200,000 tpy. Deinking and wastewater treatment will be added.

Paper sales in 1987 were $425.3 million, up from $360.4 million in 1986, and they constituted 63% of total sales.

Chesapeake shipped 829,000 tons of printing and specialty papers, 740,000 tons of tissue products, and 593,000 tons of kraft products in 1987.

Capital expenditures were $38.8 million in 1987, down from $43.2 million in 1986. Of the 1987 total, $35.3 million was spent on paper mill projects.

Chesapeake owns about 368,000 acres of timberland in four states. During 1987, 29% of wood requirements came from company land.

Production facilities:

WEST POINT, VA
Pulp—1,400 tpd softwood and hardwood kraft (450 tpd bleached for market)
Paper—320 tpd
Paperboard—1,430 tpd

MENASHA, WIS.
(Wisconsin Tissue Mills Inc.)
Pulp—deinking
Paper—300 tpd tissue

Total production capacity:

PULP	1,400 tpd
PAPER & BOARD	2,050 tpd

Consolidated-Bathurst Inc.

800 Dorchester Blvd.
W. Montreal, Que. H3B 1Y9
William I.M. Turner Jr., chairman/chief executive officer

(Owned 40% by Power Corp. of Canada, 15% by Associated Newspapers, U.K. Power Corp. and Con-Bath each own 25% of Celgar Pulp Co.; China International Trust & Investment Corp. owns 50%. In June 1988, Kuwait Investment Office offered to buy a 10.3% holding for US$161.9 million)

Net sales (C$):	
1987	$2,261,430,000
1986	2,017,834,000
1985	1,727,468,000
1984	1,622,984,000
Net earnings (C$):	
1987	214,415,000
1986	49,417,000
1985	77,564,000
1984	58,901,000

Con-Bath is a forest products and packaging organization with three business sectors: pulp and paper in North America (includes wood products) and U.K.; North American packaging companies (CB Pak and MacMillan Bathurst); and Europa Carton in Fed. Rep. Germany and the Netherlands.

In 1986, Con-Bath, Power Corp., and CITIC acquired Westar Timber Ltd.'s Castlegar, B.C., market pulp mill. Con-Bath is the technical and operating partner, and output of specialty softwood pulp grades is shared equally with CITIC. The joint ownership, and Con-Bath's first venture into western Canada, also provides a link to the Chinese market.

Net sales for Con-Bath exceeded $1 billion in 1986 for the first time, and they were also over that mark in 1987. Net sales of the pulp and paper group in 1987 were $1,139 million.

Output from Canadian pulp and paper mills was 1.69 million metric tons in 1987, and the Celgar mill produced 192,000 metric tons of pulp. Newsprint and groundwood specialties shipments reached 1.0 million tons; market pulp, 316,000; and paperboard, 359,000 tons.

Capital spending in 1987 was C$260.7, up from $231.2 million in 1986. Of this, $170.4 million went for pulp and paper projects. A big-ticket item was $94.3 million for a new corrugating medium machine at Bathurst Div. The machine will replace two others and have capacity for 150,000 metric tpy.

In late 1987, the company announced a C$280-million project to build a 183,000-metric-tpy groundwood machine at Grand-Mère, Que., to produce standard rotogravure paper, "equivalent" to supercalendered paper. Completion is set for mid-1990, at which time two older machines will be closed.

The conversion at Trois-Rivières, Que., of a 25,000-tpy machine to uncoated groundwood paper will take Con-Bath out of kraft paper production.

Con-Bath owns 337,545 acres of timberland in Canada, with control over an additional 7,640,710 acres.

Production facilities:

CASTLEGAR, B.C.
(Celgar Pulp Co.)
Pulp—560 metric tpd bleached kraft (for market) (CB's share: 280 tpd)

BATHURST, N.B.
Pulp—450 metric tpd bleached chemi-thermomechanical pulp; 275 tpd semichemical
Corrugating medium—300 metric tpd

GRAND-MERE, QUE.
(Laurentide Div.)
Pulp—345 metric tpd groundwood; 135 tpd very-high-yield sulfite
Groundwood specialties—510 metric tpd
Paperboard—100 metric tpd

NEW RICHMOND, QUE.
(Chaleurs Div.)
Pulp—535 metric tpd unbleached kraft
Linerboard—570 metric tpd

PORTAGE-du-FORT, QUE.
(Pontiac Div.)
Pulp—570 metric tpd bleached kraft (for market)

SHAWINIGAN, QUE.
(Belgo Div.)
Pulp—690 metric tpd groundwood; 270 tpd high-yield sulfite
Newsprint—890 metric tpd

TROIS RIVIERES, QUE
(Wayagamack Div.)
Pulp—250 metric tpd unbleached and semibleached kraft, 300 tpd groundwood
Groundwood specialties—435 metric tpd
Kraft paper—124 metric tpd

VILLE de la BAIE, QUE
Port Alfred Div.)
Pulp—430 metric tpd groundwood; 270 metric tpd high-yield sulfite, 245 metric tpd thermomechanical
Newsprint—975 metric tpd

Total production capacity:

PULP	
Kraft	1,635 metric tpd
Semichemical	275 metric tpd
Groundwood	1,765 metric tpd
TMP	245 metric tpd
BCTMP	450 metric tpd
Very-high-yield sulfite	135 metric tpd
High-yield sulfite	540 metric tpd
Total	5,045 metric tpd

PAPER & BOARD	
Newsprint	1,865 metric tpd
Groundwood specialties	945 metric tpd
Linerboard	570 metric tpd
Corrugating medium	300 metric tpd
Kraft paper	124 metric tpd
Paperboard	100 metric tpd
Total	3,904 metric tpd

Consolidated Papers Inc.

Box 50
Wisconsin Rapids, Wis. 54494
George W. Mead, chairman/chief executive officer

Net sales:	
1987	$742,835,000
1986	653,040,000
1985	715,744,000
1984	686,328,000
Net income	
1987	95,798,000
1986	87,542,000
1985	106,881,000
1984	80,588,000

Consolidated Papers is a leading producer of coated free-sheet and lightweight coated groundwood grades.

Key to Consolidated's strategy is ongoing capital expenditure projects to improve productivity and quality at its five Wisconsin mills. This has enabled the company to retain its reputation as a low-cost, high-quality producer.

Total shipments in 1987 were 871,079 tons, with enamel papers accounting for 745,055 tons; specialty papers, 55,990 tons; and paperboard, 4,173 tons. The Kraft Div. supplied 203,954 tons of chemical pulp in 1987.

Capital spending in 1987 was $69.2 million, and $96.7 million was authorized for 1988.

In late 1986, the Biron Div. started its 180,000-tpy lightweight coated No. 26 machine to make 34- to 40-lb enamel coated papers at a cost of $215 million, increasing total output to 490,000 tpy.

The Wisconsin Rapids Div. will rebuild No. 14 coated free-sheet machine and increase coating capabilities by 10,000 tpy. The Kraft Div. will spend $48 million to add pulp capacity to reach a total 1,000 tpd and come closer to meeting the needs of Wisconsin Rapid's 660-tpd coated groundwood No. 26 machine.

In late 1987, a $96.7-million expenditure plan was announced that includes $46 million for chemical pulp expansion at the Kraft Div. in Wisconsin Rapids, Wis. Output will rise from 680 to 1,000 tpd when the project is completed in 1989.

Consolidated holds 673,095 acres of timberland in the U.S. and Canada.

Production facilities:

STEVENS POINT, WIS.
(Stevens Point Div.)
Specialty paper—155 tpd

STEVENS POINT, WIS.
(Wisconsin River Div.)
Pulp—256 tpd groundwood
Book paper—631 tpd

WISCONSIN RAPIDS, WIS.
(Wisconsin Rapids Div.)
Enamel paper—629 tpd
Paperboard—95 tpd

WISCONSIN RAPIDS, WIS.
(Biron Div.)
Pulp—536 tpd groundwood
Book paper—789 tpd

WISCONSIN RAPIDS, WIS.
(Kraft Div.)
Pulp—667 tpd kraft

Total production capacity:

PULP	
Groundwood	792 tpd
Kraft	667 tpd
Total	1,459 tpd

PAPER & BOARD	
Book paper	1,420 tpd
Enamel paper	629 tpd
Specialty paper	155 tpd
Paperboard	95 tpd
Total	2,299 tpd

Crown Forest Industries Ltd.

700–815 West Hastings St.
Vancouver, B.C. V6C 2Y4
Ian Donald, president/chief executive officer

(Fletcher Challenge Ltd. of New Zealand holds 100% of CFI and a 69% interest in British Columbia Forest Products Ltd. These two major British Columbia forest products companies were recently brought together under a new management structure to be called Fletcher Challenge Canada Ltd. The combination of the two companies is expected to result in significant savings in production, marketing, and transportation.)

Net sales (C$):	
1987	$1,029,200,000
1986	864,200,000
1985	853,000,000
1984	740,800,000
Net earnings (C$):	
1987	100,700,000
1986*	38,300,000
1985	16,600,000
1984	–4,900,000

*after extraordinary items

Crown Forest Ltd. produces mainly newsprint and market pulp at its Elk Falls, B.C., mill as well as some linerboard and kraft paper. The company also is a major lumber and wood panel manufacturer and has a variety of converting and distribution operations.

Forest Products sales in 1987 were C$766.3 million, 74% of total sales, up from $588.7 million in 1986. Net earnings were $90 million, 89% of total net earnings.

In 1987, market pulp output was 186,000 metric tons. Newsprint output reached 464,000 metric tons, and paperboard reached 85,000 metric tons.

Crown Forest spent about $100 million from 1985-87 on capital improvements in the Forest Products sector.

Production facilities:

CAMPBELL RIVER, B.C.
(Elk Falls Mill)
Pulp—1,035 metric tpd kraft (510 tpd bleached for market); 1,250 tpd thermomechanical
Newsprint—1,280 metric tpd
Kraft specialties and linerboard—240 metric tpd

Total production capacity:

PULP	
Kraft	1,035 metric tpd
TMP	1,250 metric tpd
Total	2,285 metric tpd

PAPER & BOARD	
Newsprint	1,280 metric tpd
Kraft specialties/ linerboard	240 metric tpd
Total	1,520 metric tpd

Daishowa International

(Sub. of Daishowa Paper Manufacturing Co. Ltd., Japan)
Yomoji Saito, president

Financial data not available

Daishowa America Co. Ltd.
(Sub. of Daishowa International)
1001 4th Ave. Plaza, Suite 3103
Seattle, Wash. 98154
Seiichi Taniguchi, executive vice president

In November 1987, James River Corp. announced it would sell its Port Angeles, Wash., groundwood papers mill (acquired with the purchase of Crown Zellerbach Corp. mills) to Daishowa America. Earlier in the year, Daishowa had come close to the purchase of a Louisiana Pacific Corp. linerboard mill.

In spring 1988, Daishowa was conducting a feasibility study for addition of two new paper machines at Port Angeles, one for newsprint and the other for uncoated groundwood directory paper.

Daishowa Canada Co. Ltd.
(Sub. of Daishowa International)
Box 11595, 650 W. Georgia St.
Vancouver, B.C. V6B 4N8
Koichi Kitatawa, vice president/general manager

(Daishowa-Marubeni International Ltd. owns half of Cariboo Pulp & Paper Co.'s bleached kraft pulp mill; Daishowa Canada owns half of Quesnel River Pulp Co.'s thermomechanical and chemi-thermomechanical pulp mill. In June 1988, Reed International plc announced it would sell its North American paper group to Daishowa Canada.)

Construction by Daishowa Canada of a 340,000-metric-tpy bleached kraft pulp mill in northern Alberta reached the final feasibility study stage in late 1987 and was given the go-ahead early the next year. Construction on the C$500-million mill, near Peace River, Alta., was to begin in spring 1988 with startup in 1990. Using local aspen and equipped for oxygen delignification, the pulp mill will be one of the largest in Canada. Most of the output will be marketed in Japan.

Daishowa was also reported to be interested in building a greenfield mill in British Columbia. A key question is availability of timber.

At the Cariboo mill, a C$30-million plan to increase kraft market pulp capacity by 100 to 150 metric tpd is awaiting approval, and Quesnel River announced expansion plans early in 1987.

Production facilities:

PORT ANGELES, WASH.
(Daishowa America Co. Ltd.)
Pulp—315 tpd (285 metric) stone groundwood, thermomechanical
Directory paper—430 tpd (390 metric)

QUESNEL, B.C.
(Cariboo Pulp & Paper Co.)
Pulp—800 metric tpd bleached kraft (Daishowa-Marubeni's share: 400 metric tpd)

QUESNEL, B.C.
(Quesnel River Pulp Co.)
Pulp—490 metric tpd thermomechanical (Daishowa Canada's share: 245 metric tpd)

Total production capacity:

PULP	
Kraft	400 metric tpd
GWD/TMP	530 metric tpd
Total	930 metric tpd
PAPER	390 metric tpd

Domtar Inc.

395 de Maisonneuve Blvd. W.
Montreal, Que. H3A 1L6
James H. Smith, president/chief executive officer

(More than 45% of Domtar is jointly owned by Caisse de Dépôt du Placement du Québec, and Soc. Générale de Financement du Québec. In 1986, the government tried to sell its interest in Domtar—along with Donohue Inc.—but in early 1987 deferred the Domtar sale for lack of offers.)

Net sales (C$):	
1987	$2,568,000,000
1986	2,327,000,000
1985	2,130,000,000
1984	2,044,000,000
Net income (C$):	
1987	161,000,000
1986	145,000,000
1985	110,000,000
1984	90,000,000

Domtar is a diversified Canadian producer of pulp, paper (42% of total sales in 1987), packaging, construction materials, chemicals, and oil and gas. The company is Canada's largest paper distributor and a major domestic corrugated box converter. In its paper segment, the company has been emphasizing expansion into uncoated free-sheet papers.

Fine paper sales in 1987 were C$597 million; sales of newsprint, groundwood specialties, pulp, and lumber were $473 million.

In 1987, the company produced 389,283 metric tons of newsprint and groundwood specialties, 351,882 metric tons of fine and specialty papers, 163,779 metric tons of market pulp, 411,900 metric tons of containerboard, and 3,364 million ft^2 of gypsum wallboard.

Capital spending in 1987 reached C$767 million. Of $475 million spent in 1986 on capital investments, $269 million was for rehabilitation of the fine papers complex at Windsor, Que. The first new paper machine was online by early 1988, and the second will be operational in early 1989; at this time, the mill will have capacity for 350,000 short tpy. The mill will have capacity for 350,000 metric tpy of fine paper. Pulp will be sold on the market until the second machine starts up. The conversion of the pulp mill at Dolbeau, Que., to chemi-thermomechanical pulp continued.

Domtar plans to increase output of gypsum liner at the Lockport, N.Y., mill from 55,000 tpy to 80,000 tpy by 1990.

Domtar owns 988,000 acres of timberland in Canada and U.S., and it controls or has cutting rights on another 7,657,000 acres in Canada. About half of the company's 2.6 million metric tons of pulp needs comes from these lands.

Production facilities:

Pulp & Paper Group:

CORNWALL, ONT.
(Fine Papers Div.)
Pulp—333 metric tpd kraft
Fine paper—756 metric tpd

DON VALLEY (Toronto), ONT.
(Fine Papers Div.)
Fine paper—35 metric tpd

ST. CATHARINES, ONT.
(Fine Papers Div.)
Fine paper—180 metric tpd

BEAUHARNOIS, QUE.
(Fine Papers Div.)
Fine paper—57 metric tpd

DOLBEAU, QUE.
(Newsprint & Kraft Pulp Div.)
Pulp—600 metric tpd chemi-thermomechanical
Newsprint—500 metric tpd

DONNACONA, QUE.
(Newsprint & Kraft Pulp Div.)
Pulp—500 metric tpd thermomechanical
Newsprint and groundwood printing paper—500 metric tpd

LEBEL-sur-QUEVILLON, QUE.
(Newsprint & Kraft Pulp Div.)
Pulp—720 metric tpd kraft (for market)

WINDSOR, QUE
(Fine Papers Div.)
Pulp—403 metric tpd kraft (200 tpd for market)
Fine paper—254 metric tpd
Kraft paper—27 metric tpd

Packaging Group:

MISSISSAUGA, ONT
Linerboard—249 metric tpd

RED ROCK, ONT
Pulp—667 metric tpd kraft, 163 tpd groundwood
Linerboard—608 metric tpd
Newsprint—200 metric tpd

TRENTON, ONT
Pulp—136 metric tpd semichemical
Corrugating medium—280 metric tpd

Construction Materials Group, Gypsum Products:

SAN LEANDRO, CALIF
(Domtar Gypsum Inc.)
Chipboard, gypsum linerboard—150 short tpd (136 metric)

VERNON,CALIF
(Domtar Gypsum Inc., formerly Genstar Gypsum Products Co. mill)
Gypsum paper—165 short tpd (150 metric)

LOCKPORT, N.Y.
(Upson Products Div.
Gypsum linerboard—170 short tpd (154 metric)

Total production capacity:

PULP	
Kraft	2,123 metric tpd
Groundwood	163 metric tpd
Semichemical	136 metric tpd
TMP	500 metric tpd
CTMP	600 metric tpd
Total	3,522 metric tpd

PAPER & BOARD	
Newsprint, groundwood, printing	1,200 metric tpd
Fine paper	1,282 metric tpd
Kraft paper	27 metric tpd
Linerboard	857 metric tpd
Corrugating medium	280 metric tpd
Gypsum paper/board	440 metric tpd
Total	4,086 metric tpd

Donohue Inc.

1150 Claire-Fontaine
Quebec City, Que. G1R 5G4
Edward P. Walsh, president/chief executive officer

(In July 1987 the Quebec government, through its Dofor Inc. subsidiary, completed the sale of its 55.25% share in Donohue to a new firm, Mircor Inc., owned by Quebecor Inc. of Montreal, Que., and British Printing & Communication Corp. plc of London, U.K., which have 51% and 49% of the shares, respectively, and thus 29% and 27% of Donohue.

(Donohue owns 55% of Donohue St-Félicien Inc.; British Columbia Forest Products Ltd. owns 45%. Donohue owns 58.1% of Donohue Normick Inc.; Normick Perron Inc. owns 41.9%. In the four-machine mill at Clermont, Que., Donohue owns 55.4% of one-machine Donohue Charlevoix Inc., Gannett Co. owns 44.6%. Donohue owns 51% of Donohue Malbaie Inc., also at Clermont; the New York Times Co. owns 49%. In addition, Donohue has two other paper machines at this mill.)

Net sales (C$)	
1987	$510,054,000
1986	475,610,000
1985	424,971,000
1984	438,613,000
Net income (C$)	
1987	44,247,000
1986	24,473,000
1985	20,673,000
1984	30,288,000

Donohue Inc. has been a heavy capital spender in recent years, with its involvement in construction of the $280-million pulp mill in 1978 (Donohue St-Félicien), a greenfield newsprint mill in 1982 (Donohue Normick Inc.), and a new thermomechanical pulping system and newsprint machine at its existing newsprint mill. As a result, Donohue has some of the most modern, large scale mills in the Canadian industry.

Market pulp output in 1987 totaled 280,813 metric tons, down from a record 302,749 tons in 1986. Newsprint production was 401,628 metric tons, up from 389,116 tons in 1986.

Clermont produced a record 240,280 metric tons of newsprint in 1987, up from 213,875 tons in 1986. The Amos mill produced 161,348 metric tons in 1987, down from 175,241 tons in 1986. The St.-Félicien pulp mill produced 280,400 metric tons of market pulp in 1987, down from a record 302,400 tons in 1986.

The thermomechanical pulp mill at Clermont, completed in 1985 at a cost of $118 million, is claimed by Donohue to be the world's largest; it supplies all of Clermont's pulp needs. Early in 1988, Donohue received tentative approval of its directors to install a C$30-million deinking plant to provide furnish for newsprint machines and to reduce the amount of virgin fiber needed.

A $170-million newsprint machine installed by Donohue Malbaie, came online in late 1987. No. 3 machine was shut down at that time, but there was a net capacity increase of 140,000 metric tpy.

Normick Perron is interested in building a second newsprint machine at Amos, and may consider a greenfield mill if the Amos expansion does not work out.

Donohue's plan to build a supercalendered paper mill at Matane, Que., was changed in spring 1988; instead, a C$287.5-million, 190,000-metric tpy bleached chemi-thermomechanical pulp market mill will be built. A new company, Donohue Matane Inc., was formed with Donohue holding 51% and Rexfor, a Quebec government agency, holding 49%. The mill is scheduled to be online in summer 1990.

Production facilities:

AMOS, QUE.
(Donohue Normick Inc.)
Pulp—535 metric tpd thermomechanical
Newsprint—470 metric tpd

CLERMONT, QUE.
Pulp—1,100 metric tpd thermomechanical; 150 metric tpd sulfite, 615 tpd groundwood
Newsprint—715 metric tpd

MATANE, QUE.
(Donohue Matane Inc. proposed mill)
Pulp—535 metric tpd bleached chemi-thermomechanical

ST-FELICIEN, QUE.
(Donohue St-Félicien)
Pulp—850 metric tpd bleached kraft for market (Donohue's share—468 tpd)

Total production capacity:

PULP	
Sulfite	150 metric tpd
Groundwood	615 metric tpd
TMP	1,635 metric tpd
Kraft	468 metric tpd
Total*	2,868 metric tpd

PAPER	
Newsprint	1,185 metric tpd

*does not include Matane

Eddy Paper Co. Ltd.

1335 Carling Ave.
Box 3521, Station C
Ottawa, Ont. K1Y 4L5
J.C. Scarth, president/chief executive officer

(A wholly owned subsidiary of George Weston Ltd., Eddy Paper in turn owns E.B. Eddy Forest Products Ltd. and Eastern Fine Paper Inc.)

Net sales, Forest Products (C$):	
1987	$659,000,000
1986	564,000,000
1985	526,000,000
1984	533,000,000

Operating income (C$):	
1987	68,000,000
1986	56,000,000
1985	36,000,000
1984	40,000,000

Eddy Paper Co. Ltd. is a producer of fine paper, tissue, specialty papers, and market pulp. It transfers market pulp from its 300,000-metric-tpy Espanola, Ont., mill to its nonintegrated paper mills at Ottawa, Ont.; Hull, Que.; and Brewer, Maine. About 30,000 tons of market pulp are sold on the outside. In 1987, the company agreed to acquire Pentair Inc.'s Port Huron, Mich., paper mill. Most of Eddy's machines are relatively old and the company may require some future rationalization. There has been speculation that Eddy might shut down its Ottawa mill and sell the valuable land.

About 87% of total sales are derived from the pulp, paper, and paperboard sector. In 1987, Eddy produced 330,000 metric tons of fine and specialty paper, 55,000 tons of tissue, and 319,000 metric tons of sulfite market pulp. In 1986, the figures were 308,000 metric tons of paper and 306,200 metric tons of pulp.

Capital expenditures in 1987 were C$37 million for Forest Products, down from $41.5 million in 1986.

At the Espanola, Ont., mill, Phase 2 of the rebuild of No. 2 specialty paper machine was completed. No. 3 at the mill will be rebuilt by 1989. At Hull and Ottawa, machine improvements were made.

Eddy cuts timber on 6,208,000 acres of Crown woodlands in Canada.

Production facilities:

ESPANOLA, ONT.
(E.B. Eddy Forest Products)
Pulp—900 metric tpd kraft (290 tpd for market)
Fine paper—23 metric tpd

OTTAWA, ONT.
(E.B. Eddy Forest Products)
Fine & specialty paper—168 metric tpd

HULL, QUE.
(E.B. Eddy Forest Products)
Tissue—245 metric tpd
Fine & specialty paper—260 metric tpd

BREWER, MAINE
(Eastern Fine Paper Inc.)
Printing/writing and related paper—170 short tpd (154 metric)

PORT HURON, MICH.
(E.B. Eddy Paper Inc., former Port Huron Paper Corp. mill owned by Pentair Inc.)
Specialty paper—235 short tpd (213 metric)

Total production capacity:

PULP	900 metric tpd
PAPER	
Fine/specialty	818 metric tpd
Tissue	245 metric tpd
Total	1,063 metric tpd

Eurocan Pulp & Paper Co.

Box 1400
Kitimat, B.C. V8C 2H1
Kari Suopanki, president/chief executive officer

[Eurocan is a joint venture between Enso Forest Products Ltd. (division of Enso-Gutzeit Oy, Finland) and West Fraser Timber Co. Ltd.]

Net sales (C$):	
1987	$318,000,000
1986	283,000,000
1985	236,000,000
1984	210,000,000

Since starting up in 1971 under the ownership of three Finnish companies, this interior British Columbia mill has had an uneven financial performance due to market fluctuations for its principal products—linerboard and kraft paper. There have been a number of ownership changes, the most recent when West Fraser bought 50% control of the company in 1981-84.

Linerboard and kraft paper account for 56% of total sales, and amounted to 345,300 metric tons in 1986. Profitability has been improving, helped by strong demand from Far Eastern markets.

In spring 1988, Eurocan announced a C$126-million project to raise linerboard capacity by 105,000 metric tpy and increase pulping capacity by an equivalent amount. The board machine part of the project will be completed late in 1989. A new chemimechanical pulp line will be installed. By late 1989, the Kitimat mill will have capacity for 372,000 metric tons of linerboard and 102,000 metric tpy of sack kraft paper.

Production facilities:

KITIMAT, B.C.
Pulp—950 metric tpd kraft
Linerboard and kraft paper—1,010 metric tpd

Total production capacity:

PULP	950 metric tpd
PAPER & BOARD	1,010 metric tpd

Federal Paper Board Co. Inc.

75 Chestnut Ridge Rd.
Montvale, N.J. 07645
John R. Kennedy Jr., president/chief executive officer

Net sales:	
1987	$1,025,727,000
1986	948,560,000
1985	783,927,000
1984	637,450,000
Net income:	
1987	65,763,000
1986	18,410,000
1985	11,196,000
1984	37,075,000

Federal's operations are in three divisions: Forest Products (bleached paperboard and pulp, wood products, and lumber); Recycled Paperboard; Packaging and Printing. All but 1% of sales are derived from pulp, paper, paperboard, and converting operations. Federal bought the Augusta, Ga., bleached board mill from Continental Forest Industries Inc. in 1985. The same year, it bought the Nabisco Inc. mill in Marseilles, Ill., and then sold it to a company which shipped the equipment to Hong Kong. Early in 1988, it announced it would sell the Richmond, Va., mill to Sonoco Products Co. The California operation is also up for sale.

Total sales (intersegment and unaffiliated customers) of bleached paperboard and pulp in 1987 were $556.5 million, up from $597.8 million in 1986. Sales of bleached paperboard to unaffiliated customers in 1987 were $433.5 million, up from $432.3 million in 1986; and pulp sales were $188 million in 1987, up from $128.7 million in 1986. Recycled paperboard sales in 1987 were $98.8 million, down from $100.2 million in 1986.

Production of recycled paperboard in 1987 was 211,000 tons. Output of pulp was 1,150,000 tons, of which 675,000 tons were used by Federal paperboard mills.

Capital expenditures were $179.8 million in 1987, with $145.7 million for bleached paperboard and pulp and $145 million for recycled paperboard projects. Federal will spend $400 million over three years to increase pulping capacity at the Augusta, Ga., mill and to rebuild No. 3 bleached paperboard machine. Paperboard capacity will be raised to 1,800 tpd, and pulping capacity will be increased to support the additional paperboard output.

Federal owns 558,000 acres of timberland in U.S., and it controls an additional 132,000 acres. In 1987, about 27% of softwood and 9% of hardwood requirements came from these woodlands.

Production facilities:

CITY OF COMMERCE, CALIF.
Recycled board—168 tpd

VERSAILLES, CONN.
Sprague Div.)
Recycled board—504 tpd

AUGUSTA, GA.
Pulp—1,720 tpd bleached kraft (110 tpd for market)
Bleached paperboard—1,370 tpd

RIEGELWOOD, N.C.
Pulp—2,180 tpd bleached kraft (1,155 tpd for market)
Bleached paperboard—1,025 tpd

Total production capacity:

PULP	3,900 tpd
PAPERBOARD	
Bleached paperboard	2,395 tpd
Recycled paperboard	672 tpd
Total	3,067 tpd

Fort Howard Corp.

1919 S. Broadway
Green Bay, Wis. 54304-9191
Paul J. Schierl, chairman/chief executive officer

Net sales:	
1987	$1,757,728,000
1986	1,549,290,000
1985	1,363,292,000
1984	1,338,588,000
Net earnings:	
1987	$157,738,000
1986	146,391,000
1985	157,010,000
1984	133,076,000

Fort Howard manufactures and distributes a wide array of paper and paper-related products for in-home and away-from-home markets. Included are facial and bathroom tissue, towels, napkins, wipers, printed specialties, cups, plates, and food and dairy packaging containers. Raw material is wastepaper and paperboard. The company has expanded in the disposable food-service market through acquisitions (Maryland Cup and Lily-Tulip Inc.). The company dropped "Paper" from its name in 1987, reflecting the fact that more than half its sales come from plastic products.

The company operates highly efficient mills which use its proprietary wastepaper deinking technology. Profit margins have been under pressure recently because of competitive market conditions in tissue and because of the need to restructure its newly acquired food service businesses.

Sanitary tissue products accounted for 29% of total 1987 sales, down from 30% in 1986 and 33% in 1985.

Capital expenditures in 1986 were $355 million, while expenditures in 1987 were estimated at $250 million. The biggest ongoing capital expenditure project, accounting for some $175 million, is the greenfield mill at Rincon, Ga. Construction began in 1985, converting operations started in 1986, the first tissue machine went online in spring 1987, and the second went online a year later. Both of these units have capacity for 250 tpd of recycled tissue. The third machine will be running by late 1989. The original plan was to have four tissue machines by 1993, with a total capacity of 515,000 tpy.

At Green Bay, Wis., the company's ninth tissue machine was approved late in 1987, and early the next year the company announced it would build its tenth unit, a dry-former tissue machine (which would be the mill's second such machine) for 1989 startup.

Fort Howard's share of the tissue market is estimated to be 14.9%; this will increase to 20.7% when all new machines are in place. In the commercial tissue sector, it claims about 31%, with an anticipated increase to 33.2% by 1993.

Production facilities:

(Fort Howard does not release capacity data; figures below are estimates.)

RINCON, GA.
(Savannah River Mill)
Pulp—deinked
Paper—375 tpd (1987)

MUSKOGEE, OKLA.
Pulp—775 tpd deinked
Tissue, toweling, napkins—975 tpd

GREEN BAY, WIS.
Pulp—775 tpd deinked
Tissue, toweling, napkins—990 tpd

Total production capacity:

PULP	
Deinked	1,550 tpd
PAPER	
Tissue, towel, napkin	2,340 tpd

Garden State Paper Co. Inc.

600 E. Broad St.
Richmond, Va. 23219
Basil Snider Jr., president/chief executive officer

(A wholly-owned subsidiary of Media General Inc., which also has a 33% interest in Southeast Paper Mfg. Co. FSC Paper Corp., in which Media General had a 20% interest, was sold to Smorgon Consolidated Industries Pty Ltd. of Australia in May 1987.)

Garden State Paper Co. Inc.

Net sales:	
1986	$169,989,000
1985	170,713,000
1984	179,024,000

Media General Inc.

Newsprint segment revenues:	
1987	$204,113,000
1986	173,402,000
1985	174,893,000
1984	182,333,000
Operating profit:	
1987	$36,278,000
1986	17,284,000
1985	17,730,000
1984	19,860,000

Media General was the third largest newsprint producer in the U.S. and the world's largest producer of recycled newsprint prior to the sale of its interest in FSC; it then moved to fourth place, making over 570,000 tpy. Garden State mills produced 354,000 tons of newsprint in 1987, up from 333,993 tons in 1986. The company recycles about 8% of all newspapers read annually in the U.S. The paper mills utilize the Garden State technology for making newsprint.

Garden State's capital expenditures in 1987 were $9,950,000.

In November 1987, Garden State announced a $20-million project to upgrade No. 2 machine at Garfield, N.J., and increase capacity by as much as 6,000 tpy. Completion is set for January 1989.

A new machine at Southeast's Dublin, Ga., mill will about double capacity to 437,000 tpy.

Production facilities:

POMONA, CALIF.
Pulp—400 tpd deinked
Newsprint—370 tpd

GARFIELD, N.J.
Pulp—700 tpd deinked
Newsprint—585 tpd

Total production capacity:

PULP	1,100 tpd
PAPER	955 tpd

Gaylord Container Corp.

500 Lake Cook Rd., Suite 400
Deerfield, Ill. 60015
Marvin A. Pomerantz, chairman/chief executive officer

Financial data not available.

Gaylord initially consisted of three mills formerly owned by Crown Zellerbach Corp. and bought from Sir James Goldsmith in November 1986. The company is controlled by an investor group led by Marvin A. Pomerantz and Warren J. Hayford, who also control Mid-America Packaging Group (which acquired Weyerhaeuser Co.'s Pine Bluff, Ark., mill in 1986).

Early in 1988, Gaylord agreed to acquire assets of the Container Products Div. of Louisiana-Pacific Corp.'s Fibreboard Corp. subsidiary, including the Antioch, Calif., mill; box plants in Phoenix, Ariz., and Sacramento Calif., and inventories of these facilities. The $156-million acquisition was completed in April. Also in spring 1988, the company decided to sell the Baltimore, Ohio, recycled containerboard mill.

A plan in fall 1987 to take the company public through a stock offering and to combine the two corporate entities was delayed repeatedly due to market conditions. However, Mid-America Packaging Inc. was merged with Gaylord in June 1988. Shortly before that, an ambitious spending program was announced to increase capacity, improve product quality, and achieve operating efficiencies. Included in the spending plans are $75 million in 1988 and $133 million by 1990. The largest item is installation of a 1,000 tpd linerboard machine at the Bogalusa, La., mill, adding 1,500 tpd capacity and boosting total output of linerboard and kraft paper to 2,500 tpd (if no existing machines are shut down). Startup date for the $100-million project is 1990. The two Antioch, Calif., mills will be linked to improve product quality and increase capacity while saving on costs. Included in this project are a pulp mill upgrade and machine rebuild. At Pine Bluff, Ark., the kraft paper mill is completing a $20-million modernization program that began in 1986. Additional investments will be made in the company's corrugated container and sheet plants.

Combined sales for Gaylord and Mid-America Packaging for the fiscal year ending September 1987 were close to $600 million on a pro forma basis.

Production facilities:

PINE BLUFF, ARK.
(Mid-America Packaging Inc.)
Pulp—330 tpd kraft
Paper—315 tpd bag, sack

ANTIOCH, CALIF.
Recycled paperboard—600 tpd

ANTIOCH, CALIF.
(Former Fibreboard Corp., Container Products Div. mill)
Pulp—600 tpd unbleached kraft, 200 tpd semichemical
Linerboard—625 tpd
Corrugating medium—225 tpd

BOGALUSA, LA.
Pulp—1,300 tpd unbleached kraft; 330 tpd semichemical
Bag paper—250 tpd
Containerboard—1,250 tpd

BALTIMORE, OHIO
(Mill up for sale)
Recycled paperboard—170 tpd

Total production capacity:

PULP	
Kraft	1,800 tpd
Semichemical	530 tpd
Total	2,330 tpd
PAPER & BOARD	
Bag paper	250 tpd
Containerboard	2,100 tpd
Recycled paperboard	770 tpd
Total	3,120 tpd

Georgia-Pacific Corp.

133 Peachtree St. N.E.
Atlanta, Ga. 30303
T. Marshall Hahn Jr., chairman/chief executive officer

Net sales:	
1987	$8,603,000,000
1986	7,223,000,000
1985	6,716,000,000
1984	6,682,000,000
Net income:*	
1987	458,000,000
1986	296,000,000
1985	207,000,000
1984	253,000,000

*continuing operations, before unusual items

Georgia-Pacific, one of the largest U.S. producers of building materials, has modified its strategy to achieve a better balance between its paper and building products sectors and to even out performance in business cycles. It is also integrating further, installing two white paper machines at Port Hudson, La., where there was formerly only a market pulp operation. It has switched grades from one mill to another or added grades for optimum mill performance. G-P got out of the chemicals and oil and gas businesses, but has added cut-size converting operations at three mills. G-P sold its Tomahawk, Wis., and Lyons Falls, N.Y., mills in 1985.

The company recently acquired Brunswick Pulp & Paper Co. from Mead Corp. and Scott Paper Co. for $665 million, expanding G-P's position in market pulp and bleached board. G-P also recently sold off four diaper converting plants acquired two years earlier.

Sales of pulp and paper in 1987 were $2.9 billion (33% of G-P total). Of this, 15% or $1.246 million was from containerboard and packaging; 6% from tissue ($539,000); 7% from printing/writing papers ($621,000); 4% from market pulp ($314,000); and 1% from other ($90,000).

Pulp output in 1987 was 4,277,000 tons; paper, 3,417,000 tons; and tissue, 422,000 tons. Comparable 1986 figures were 3,970,000, 3,135,000, and 437,000, respectively. G-P had capacity at the end of 1987 for 4,495,000 tons of pulp, 3,595,000 tons of paper, and 471,000 tons of tissue.

Capital expenditures for 1987 were $359 million for pulp and paper projects; they totaled $213 million in 1986. Overall, capital investments have led to almost doubled capacity, broader markets, and upgraded quality.

G-P recently rebuilt the No. 2 linerboard machine at Monticello, Miss., to add 500 tpd to the mill's 1988 capacity of 2,200 tpd. No. 1 machine was rebuilt following acquisition of the mill in 1984.

In early 1987, G-P introduced a new grade of tissue which will be made at Bellingham, Wash.; Crossett, Ark.; Plattsburgh, N.Y.; and Palatka, Fla. At the latter mill, No. 5 tissue machine was replaced with a twin-wire machine for spring 1988 startup.

A $185-million, 824-tpd uncoated free-sheet machine is slated for the Port Hudson mill at Zachary, La., for late 1988 startup. In mid-1987, the go-ahead was given for a 400-tpd expansion in market pulp capacity in a $100-million project which will bring total capacity to 1,220 tpd. A new paper machine at the mill began operation in April 1986, producing 600 tpd of printing paper.

Linerboard production at Monticello, Miss., was increased to 2,200 tpd in 1986, up from 1,600 tpd when the plant was acquired in 1984. Printing paper and bleached foodboard output at Crossett, Ark., was also increased.

G-P owns 4,910,000 acres of timberland in North America, and controls 670,000 more.

Production facilities:

BRUNSWICK, GA.
Pulp—1,800 tpd kraft (1,470 market)
Bleached board—530 tpd

CROSSETT, ARK.
Pulp—1,510 tpd kraft; 127 tpd deinked
Printing paper—507 tpd
Tissue and towel—456 tpd
Solid bleached board—482 tpd

PALATKA, FLA.
Pulp—1,366 tpd kraft (68 tpd for market); 20 tpd deinked
Kraft paper—620 tpd
Tissue & toweling—479 tpd

TAYLORVILLE, ILL.
Pulp—17 tpd deinked
Printing/writing paper—115 tpd

GARY, IND.
Pulp—76 tpd deinked
Tissue and towel—76 tpd

PORT HUDSON (Zachary), LA
Pulp—845 tpd bleached kraft (798 for market)
Printing paper—650 tpd

WOODLAND, MAINE
Pulp—839 tpd kraft (461 tpd for market)
Printing paper—310 tpd

KALAMAZOO, MICH.
Pulp—127 tpd deinked
Printing paper—394 tpd

MONTICELLO, MISS.
Pulp—2,214 tpd kraft
Kraft linerboard—2,200 tpd

DELAIR, N.J.
Pulp—237 tpd deinked
Gypsum paperboard—206 tpd

PLATTSBURGH, N.Y.
Pulp—107 tpd semichemical; 28 tpd deinked
Tissue and towel—254 tpd

PRYOR, OKLA.
Pulp—225 tpd deinked
Gypsum paperboard—239 tpd

TOLEDO, ORE.
Pulp—1,386 tpd kraft; 434 tpd deinked
Kraft paper—338 tpd
Kraft linerboard—941 tpd
Semichemical medium—493 tpd

READING, PA.
Pulp—14 tpd deinked
Printing paper—71 tpd

GILMAN, VT.
Pulp—28 tpd deinked
Printing paper—200 tpd

BELLINGHAM, WASH.
Pulp—577 tpd bleached sulfite (367 tpd for market); 113 tpd semichemical; 34 tpd deinked
Tissue and towel—248 tpd

THOROLD, ONT.
(Beaver Wood Fibre Co.)
Pulp—294 metric tpd deinked (324 short)
Gypsum paperboard—281 metric tpd (310 short)

Total production capacity:

PULP (short tons)	
Kraft	8,160 tpd
Semichemical	220 tpd
Sulfite	577 tpd
Deinked	1,691 tpd
Total	10,648 tpd
PAPER (short tons)	
Printing/writing	2,247 tpd
Tissue/toweling	1,437 tpd
Kraft paper	958 tpd
Industrial toweling	76 tpd
Total	4,718 tpd
PAPERBOARD (short tons)	
Kraft linerboard	3,141 tpd
Bleached board	482 tpd
Semichemical medium	493 tpd
Gypsum paperboard	755 tpd
Total	4,871 tpd
TOTAL PAPER & BOARD	9,589 tpd

Gilman Paper Co.

111 W. 50th St.
New York, N.Y. 10020
Howard Gilman, chairman/chief executive officer

Financial data not available.

In 1986, 60% to 70% of Gilman's sales came from pulp, paper, paperboard, and converted products. The company produced 410,000 tons of pulp and 412,000 tons of paper and paperboard. In one grade, envelope paper, it has capacity for 110,000 tpy. In 1985, Gilman closed down its Grocery Bag & Sack Div. and a converting plant near St. Louis, Mo. These closures did not affect multiwall converting operations.

Capital expenditures in 1986 totaled $10.5 million and were expected to reach $14 million in 1987. In spring 1988, Gilman announced it was spending $10 million to convert a five-stage bleach plant to two three-stage plants, giving both softwood and hardwood a dedicated line and making possible improved quality and uniformity. Gilman is shifting production to white grades.

Gilman owns 200,000 acres of timber in the U.S.

Production facilities:

ST. MARYS, GA.
(St. Marys Kraft Div.)
Pulp—1,200 tpd kraft (750 tpd bleached, 450 tpd unbleached)
Paper & board—1,200 tpd (half paper, half board; bleached and unbleached; coated and uncoated)

Total production capacity:

PULP	1,200 tpd
PAPER & BOARD	1,200 tpd

P.H. Glatfelter Co.

Main St.
Spring Grove, Pa. 17362
T.C. Norris, chairman/president/chief executive officer

(Glatfelter Pulp Wood Co. is a wholly owned subsidiary.)

Net sales:	
1987*	$423,680,000
1986	284,832,000
1985	277,144,000
1984	310,883,000
Net earnings:	
1987	55,027,000
1986	41,474,000
1985	39,731,000
1984	63,186,000

*includes Ecusta Div.

Glatfelter manufactures printing/writing and technical specialty papers. The mill at Spring Grove, Pa., is integrated, producing a substantial part of its pulp requirements from wood. The Neenah, Wis., mill utilizes wastepaper as its principal raw material, with purchases of virgin woodpulp comprising slightly less than 13% of total fiber requirements in 1985. All company sales are derived from paper and paperboard.

Early in 1987, Glatfelter bought Ecusta Corp., which operated the Pisgah Forest, N.C., mill (formerly belonging to Olin Corp.). The acquisition enabled Glatfelter to expand in thin and specialty papers.

Capital expenditures in 1987 were $62.6 million, up from $16.5 million in 1986. A $60-million fluidized bed power boiler/turbine generator at Spring Grove, Pa., scheduled for completion in 1988-89, will make the mill self-sufficient in energy and provide electricity to sell.

Company timberlands, managed by Glatfelter Pulp Wood Co., comprise 108,000 acres and supply 15% of Spring Grove's pulpwood requirements.

Production facilities:

PISGAH FOREST, N.C.
(Formerly Ecusta Corp. mill)
Pulp—250 tpd flax
Paper—300 tpd cigarette, bible, technical

SPRING GROVE, PA.
Pulp—580 tpd bleached kraft
Printing/writing paper—775 tpd

NEENAH, WIS.
(Bergstrom Paper Div.)
Pulp—225 tpd bleached deinked
Printing/writing paper—375 tpd

Total production capacity:

PULP	
Kraft	580 tpd
Deinked	225 tpd
Flax	250 tpd
Total	1,055 tpd

PAPER	
Printing/writing	1,150 tpd
Cigarette and thin	300 tpd
Total	1,450 tpd

Great Northern Nekoosa Corp.

75 Prospect St., Box 9309
Stamford, Conn. 06904
William R. Laidig,
chairman/president/chief executive officer

(Kymmene-Strömberg Corp. of Finland owns 5% of Leaf River Forest Products)

Great Northern Nekoosa Corp.

Net sales:	
1987	$2,589,000,000
1986	2,039,200,000
1985	1,934,800,000
1984	1,873,300,000
Net income:	
1987	200,600,000
1986	85,300,000
1985	46,200,000
1984	119,900,000

Owens-Illinois Inc., Forest Products Co.

Net sales:	
1986	$839,100,000
1985	836,700,000
1984	898,200,000
Operating profit:	
1986	58,400,000
1985*	43,600,000
1984*	82,900,000

*includes net pretax charges for capacity curtailment adjustments and divestitures of $4.1 million (1985) and $6.6 million (1984)

One of the largest U.S. pulp/paper/board producers, Great Northern Nekoosa had capacity for three million tpy prior to the Owens-Illinois Inc. acquisition, and 4.2 million tpy afterward. GNN concentrates on the manufacture of uncoated free-sheet paper, newsprint and groundwood printing papers, containerboard, and market pulp. It focuses on producing a few high-volume products at large, cost-efficient mills.

The company's Great Southern Paper unit was the largest nonintegrated supplier of containerboard before it shifted strategy with the 1986 acquisition of J&J Corrugated Box Corp., an independent converter with four plants.

GNN expanded further into containerboard with the $1.15-billion acquisition in September 1987 of O-I's Forest Products Group (three containerboard mills and 21 corrugated box plants, sold to reduce debt resulting from the Kohlberg Kravis Roberts & Co. buyout of O-I earlier in the year). This more than doubled GNN's containerboard capacity to about two million tons and further increased its level of integration. The O-I facilities were considered to be among the best to be put up for sale in recent years, although they were purchased at a relatively high price, which drove up GNN's debt load.

Ninety-five percent of GNN's sales come from pulp/paper/board products. In 1987, 1,485,000 tons of paper were produced (capacity: 1,574,000 tons); 2,077,000 tons of containerboard (capacity: 2,100,000 tons); and 518,000 tons of market pulp (capacity: 538,000 tons). Business papers accounted for 19.9% of shipments; newsprint and groundwood printing, 17.4%; and containerboard, 44.9%. The Leaf River Forest Products market pulp mill, which started up in 1984, has become a major profit contributor despite its high original capital cost ($560 million). It accounted for 12.8% of sales in 1987.

One problem area has been the older Great Northern newsprint/groundwood paper mills in Maine. To improve quality and reduce cost, the division began a program to reduce the number of machines, using only the most efficient and curtailing production by 20%.

Capital expenditures in 1987 were $250.3 million, up from $176.5 million in 1986. Nekoosa Papers has rebuilt two paper machines and will spend $90 million by 1989 on the Ashdown, Ark., mill to increase market pulp output by 90,000 tpy. At East Millinocket, Maine, a $200-million improvement project included the rebuild of two machines and the shutdown of two old units for a net gain in capacity of 12,000 tons, making total output 326,000 tons in 1988. A $37.5-million outlay will upgrade sulfite pulp production at Millinocket, Maine, in a project to be completed in 1989. A $7.4-million rebuild of an uncoated free-sheet machine at Port Edwards, Wis., will increase capacity by 6,000 tpy. Construction will begin in mid-1988.

GNN owns over 3.446 million acres of timberland and leases 234,000 acres.

Production facilities:

ASHDOWN, ARK.
(Nekoosa Papers)
Pulp—1,475 tpd bleached kraft (140 tpd for market)
Business communication paper—1,300 tpd

CEDAR SPRINGS, GA.
(Great Southern Paper)
Pulp—2,230 tpd kraft; 460 tpd semichemical
Linerboard—2,250 tpd
Corrugating medium—570 tpd

EAST MILLINOCKET, MAINE
(Great Northern Paper)
Pulp—725 tpd groundwood
Newsprint, groundwood printing paper—880 tpd

MILLINOCKET, MAINE
(Great Northern Paper)
Pulp—710 tpd groundwood; 525 tpd sulfite
Groundwood specialty paper—1,115 tpd

NEW AUGUSTA, MISS.
(Leaf River Forest Products)
Pulp—1,190 tpd bleached kraft pulp (for market)

NEKOOSA, WIS.
(Nekoosa Papers)
Pulp—360 tpd kraft
Business communication paper—530 tpd

PORT EDWARDS, WIS.
(Nekoosa Papers)
Pulp—250 tpd sulfite
Business communication paper—450 tpd

Nekoosa Packaging Corp.
(Formerly Owens-Illinois Inc., Forest Products Div.)

VALDOSTA, GA.
Pulp—1,015 tpd kraft
Linerboard—965 tpd

BIG ISLAND, VA.
Pulp—575 tpd semichemical
Corrugating medium—720 tpd

TOMAHAWK, WIS.
Pulp—1,200 tpd semichemical
Corrugating medium—1,200 tpd

Total production capacity:

PULP	
Kraft	6,270 tpd
Semichemical	2,235 tpd
Groundwood	1,435 tpd
Sulfite	775 tpd
Total	10,715 tpd

PAPER & BOARD	
Newsprint, GWD	1,995 tpd
Business papers	2,280 tpd
Linerboard	3,215 tpd
Corrugating medium	2,490 tpd
Total	9,985 tpd

TOTAL PAPER & BOARD 9,980 tpd

Green Bay Packaging Inc.

Box 1107
Green Bay, Wis. 54305
James F. Kress, president/chief executive officer

Financial data not available

Green Bay is a diversified, privately owned company with interests in containerboard, converting, lumber, and machinery. Arkansas Kraft Corp. is a subsidiary.

Containerboard output of Arkansas Kraft in 1987 was 352,064 tons, which included 112,756 of mottled white. The Green Bay mill produced 133,047 tons of board.

Plans were recently announced to expand the Green Bay medium mill by 400 tpd and Arkansas Kraft by 500 tpd.

Green Bay owns 200,000 acres of timber in the U.S. and controls another 50,000 acres.

Production facilities:

MORRILTON, ARK.
(Arkansas Kraft Corp.)
Pulp—800 tpd unbleached kraft
Kraft linerboard—1,075 tpd

GREEN BAY, WIS.
(Paper Mill Div.)
Pulp—220 tpd semichemical
Corrugating medium/specialty board—350 tpd

Total production capacity:

PULP	
Unbleached kraft	800 tpd
Semichemical	220 tpd
Total	1,020 tpd
PAPERBOARD	1,425 tpd

Gulf States Paper Corp.

Box 3199
Tuscaloosa, Ala. 35401
J.W. Warner, chairman/chief executive officer

Financial data not available.

A $50-million, three-year program was begun in 1985 to boost bleached kraft pulp and bleached board capacity by 20%. Capital expenditures in 1986 were $40 million and included bleached board machine modifications to add 20,000 tpy. Expenditures of $4 million in 1987 were to add 14,000 tpy.

Approximately 40,000 acres of U.S. timberlands are owned or controlled.

Production facilities:

DEMOPOLIS, ALA.
Pulp—500 tpd unbleached kraft; 50 tpd deinked
Paperboard—625 tpd bleached foodboard

Total production capacity:

PULP	550 tpd
PAPERBOARD	625 tpd

ITT Rayonier Inc.

1177 Summer St.
Stamford, Conn. 06904
Ronald M. Gross,
chairman/president/chief executive officer

(ITT Rayonier is a subsidiary of ITT Corp. ITT Rayonier jointly owns two-thirds of Grays Harbor Paper Co. with Hammermill Paper Div. of International Paper Co., which operates the mill and markets its products.)

Net sales (Forest Products Div.):	
1987	$757,000,000
1986	727,000,000
1985	680,000,000
1984	683,000,000

Although reduced in size, ITT Rayonier is still a major producer of dissolving, paper-grade, and fluff market pulp at three mills (Jesup, Ga.; Fernandina Beach, Fla.; and Port Angeles, Wash.) Of these, the Jesup kraft mill is believed to be the most modern and cost-efficient. The Hoquiam, Wash., pulp mill mainly supplies the adjacent Grays Harbor Paper joint-venture mill. The company has suffered in recent years from declining markets for dissolving pulp, weak pricing, and relatively high production costs at some mills. ITT earlier indicated that it would like to sell Rayonier, although profitability recently has been improving.

A major disaster was the Port Cartier, Que., dissolving pulp mill, which was built in the mid-1970s and then shut down in 1979. Total losses (including writedown) were estimated at $600 million. The company's two British Columbia pulp mills at Squamish and Port Alice were sold off in 1980.

In late 1985, parent ITT sold Port Cartier to Cascades Inc. and Rexfor. ITT will sell bleached chemi-thermo-mechanical pulp from this mill in U.S. and Europe, and it has marketing arrangements with other countries.

Approximately 56% of total sales, $409 million in 1986, are derived from pulp operations. The company produced 836,000 metric tons of pulp in 1986. Capacity in 1987 was 950,000 metric tpy.

Capital spending in 1987 was $55 million, down from $59 million in 1986. Of this, $7 million was for dryer improvements at Jesup. Announced late in 1987 is a $21-million project at Jesup's C mill to increase pulp capacity by 46,000 metric tpy to 550,000 metric tpy in 1989.

Most timberland properties are owned or leased by Rayonier Timberlands LP, a publicly held master limited partnership of which ITT Rayonier Inc. and Rayonier Forest Resources Co. are general partners. Timberlands comprises 1,116,000 acres owned and 146,000 acres controlled.

Production facilities:

FERNANDINA BEACH, FLA.
(Fernandina Div.)
Pulp—455 tpd sulfite (for market)

JESUP, GA.
(Jesup Div.)
Pulp—1,545 tpd bleached kraft (for market)

HOQUIAM, WASH.
(Grays Harbor Div.)
Pulp—290 tpd sulfite

HOQUIAM, WASH.
(Grays Harbor Paper Co.)
Paper (see International Paper Co.)

PORT ANGELES, WASH.
(Port Angeles Div.)
Pulp—480 tpd sulfite (for market)

Total production capacity:

PULP	
Sulfite	1,225 tpd
Kraft	1,545 tpd
Total	2,770 tpd

International Paper Co.

2 Manhattanville Rd.
Purchase, N.Y. 10577
John A. Georges, chairman/chief executive officer

(IP owns one-third of Grays Harbor Paper Co. through its acquisition of Hammermill Paper Co. In 1987, IP moved its corporate headquarters to Purchase, N.Y., and made Memphis, Tenn., operating headquarters.)

International Paper Co.

Net sales:	
1987	$7,763,000,000
1986	5,500,000,000
1985	4,502,900,000
1984	4,716,000,000

Net income:*	
1987	407,000,000
1986**	305,000,000
1985	133,300,000
1984	120,000,000

*reflects extraordinary items.
**Hammermill's fourth-quarter results included in 1986 figures.

Hammermill Paper Co.

Net sales:	
1986 (9 months)	$1,355,895,000
1985	1,876,914,000
1984	1,854,991,000
Net earnings:	
1986 (9 months)*	48,945,000
1985	28,913,000
1984	55,849,000

*before tender offer and merger expenses reduced 9-month earnings to $27,608,000.

By the second half of the 1980s, International Paper had completed a major seven-year modernization program in which $5 billion was spent upgrading a number of the major southern mills. In addition, IP underwent a major restructuring program, which included the sale of its Canadian operations in 1981, the closure of two containerboard mills and the sale of a third, and withdrawal from the newsprint business. A recent major strategic move was the 1986 purchase of Hammermill Paper Co. for $1.1 billion, expanding IP's position in the higher-value-added, faster-growth white papers.

As a result of the Hammermill acquisition, IP became the world's largest paper company, with 26 pulp and paper mills in the U.S. and two overseas. Among grades produced by the company are uncoated free-sheet, coated papers, bristols, paper and specialty pulp, containerboard, bleached board, and kraft packaging paper. In addition, the company has interests in wood products, nonwovens, specialty chemicals, oil and gas, and real estate.

Sales by the pulp and paper segment reached $2,595 million in 1987, up from $1,950 million in 1986. Paperboard and packaging sales were $2,983 million in 1987 ($2,372 million in 1986).

Output of printing/writing papers and bristols was 2,100,000 tons in 1987, up from 1,650,000 tons in 1986; publication paper output was 450,000 tons (up from 400,000 tons); and market pulp output reached 990,000 tons (up from 950,000 tons). Output of containerboard was 2,050,000 tons in 1987 (2,010,000 tons in 1986); bleached board output was 910,000 tons (950,000 tons in 1986); and industrial papers output was 620,000 tons (450,000 tons in 1986).

Capital expenditures in 1987 were $179 million for pulp and paper projects and $180 million for paperboard and packaging projects.

In 1987, IP began studying reactivation of the Durham recycled containerboard mill at Riegelsville, Pa., which it purchased in 1985 but did not restart. The mill, which has been down since 1983, would be equipped with "world-class" recycling technology new to the U.S., but this plan has not been implemented.

A $50-million modernization of the Vicksburg, Miss., linerboard mill will expand capacity by about 83,000 tpy. Completion of the project is set for spring 1989.

Hammermill and IP have converted or will convert white paper mills to the alkaline process. The Grays Harbor mill at Hoquiam, Wash., and the Ticonderoga, N.Y., mill have been converted. Next in line are mills at Erie, Pa. (spring 1988); Lock Haven, Pa. (fall 1988); and Selma, Ala., and Oswego, N.Y., may follow in 1989.

In 1985, IP put most of its 6.3 million acres of timber into a limited partnership—IP Timberlands Ltd.

Production facilities:

(IP does not release capacity figures; the following are from published sources or are estimates.)

International Paper Co.

MOBILE, ALA.
Pulp—1,035 tpd kraft
Uncoated free-sheet—1,000 tpd
Packaging/industrial converting paper—85 tpd

CAMDEN, ARK.
Pulp—800 tpd
Packaging/industrial converting paper—715 tpd

PINE BLUFF, ARK.
Pulp—1,600 tpd bleached and unbleached kraft
Publication paper—565 tpd
Solid bleached board—1,150 tpd

BASTROP, LA.
Pulp—1,200 tpd bleached kraft
Printing/writing paper—500 tpd
Solid bleached board—550 tpd

MANSFIELD, LA.
Pulp—2,050 tpd unbleached kraft
Linerboard—1,300 tpd
Corrugating medium—750 tpd

PINEVILLE, LA.
Pulp—975 tpd unbleached kraft
Unbleached kraft board—985 tpd

JAY, MAINE
Pulp—1,200 tpd bleached kraft; 245 tpd groundwood
Printing/writing paper—1,350 tpd

MOSS POINT, MISS.
Pulp—750 tpd kraft
Printing/writing paper—150 tpd
Packaging/industrial converting paper and solid bleached board—785 tpd

NATCHEZ, MISS.
Pulp—650 tpd bleached kraft; 500 dissolving (for market)

VICKSBURG, MISS.
Pulp—1,180 tpd kraft
Unbleached kraft board—1,350 tpd

CORINTH, N.Y.
Pulp—150 tpd groundwood
Printing/writing paper—480 tpd

TICONDEROGA, N.Y.
Pulp—530 tpd bleached kraft
Printing/writing paper—690 tpd

GARDINER, ORE.
Pulp—850 tpd kraft
Unbleached kraft board—850 tpd

RIEGELSVILLE, PA.
(formerly Durham Mill Inc.)
(Mill idle)
Recycled paperboard—375 tpd linerboard, specialty

GEORGETOWN, S.C.
Pulp—1,600 tpd bleached kraft (915 for market)
Uncoated free-sheet—370 tpd
Bleached bristol—345 tpd

TEXARKANA, TEXAS
Pulp—1,300 tpd kraft (estimated 500 tpd for market)
Bleached paperboard—1,300 tpd

MERRILL, WIS.
(Former Ward Paper Co. mill of Arvey Corp.)
Pulp—60 tpd deinking
Fine, specialty papers—100 tpd

Hammermill Paper Div.

SELMA, ALA.
(Riverdale Plant, HPG)
Pulp—1,100 tpd bleached kraft (440 tpd for market)
Uncoated free-sheet—530 tpd

WESTFIELD, MASS.
(Strathmore Paper Co., including facilities at Westfield, Millers Falls, Turners Falls and Woronoco, Mass.)
Printing/writing paper—130 tpd

OSWEGO, N.Y.
Printing/writing paper—210 tpd

HAMILTON, OHIO
(Beckett Paper Co.)
Printing/writing paper—150 tpd

ERIE, PA
Pulp—680 tpd Neutracel II bleached alkaline (for market)
Printing/writing paper—470 tpd

LOCK HAVEN, PA
Printing/writing paper—675 tpd

HOQUIAM, WASH.
(Grays Harbor Paper Co., jointly owned)
Printing/writing, related paper—375 tpd

DE PERE, WIS.
(Nicolet Div. of Thilmany Pulp & Paper—former Philip Morris mill)
Paper—140 tpd glassine, greaseproof, release, sanitary waxing

KAUKAUNA, WIS.
(Thilmany Pulp & Paper)
Pulp—430 tpd bleached and unbleached kraft
Packaging industrial converting paper—555 tpd

Total production capacity:

PULP	
Kraft	17,250 tpd
Groundwood	395 tpd
Dissolving	500 tpd
Neutracel	680 tpd
Deinking	60 tpd
Total	18,885 tpd
PAPER	
Printing/writing	5,745 tpd
Uncoated free-sheet	1,900 tpd
Fine	100 tpd
Specialty	140 tpd
Packaging/industrial converting*	2,140 tpd
Bleached bristols	345 tpd
Total	10,370 tpd

*includes some solid bleached board

PAPERBOARD	
Bleached paperboard	3,000 tpd
Linerboard	1,300 tpd
Unbleached kraft board	3,185 tpd
Corrugating medium	750 tpd
Recycled board	375 tpd
Total	8,610 tpd
TOTAL PAPER & BOARD	18,980 tpd

Interstate Resources Inc.

1800 N. Kent St., Suite 1200
Rosslyn, Va. 22209
Richard L. Trueb, president/chief operating officer

Financial data not available.

Interstate produced 276,392 tons of paperboard in 1986.

Capital spending in 1986 was $1.4 million and included projects for improved operating efficiencies, new secondary fiber system, and process control at Riceboro, Ga. For 1987, $4,800,000 was budgeted. A $3.5 million upgrade of the Reading, Pa., mill was completed in early 1988. The mill produced 40,000 tons of recycled medium, testliner, and other paper products in 1987 and is now selling on the open market where it formerly supplied Interstate container plants.

Production facilities:

RICEBORO, GA.
(Interstate Paper Corp.)
Pulp—530 tpd kraft
Linerboard—690 tpd

READING, PA.
(Interstate Intercorr Corp.)
Containerboard—100 tpd corrugating medium; testliner; core, can, tube stock

Total production capacity:

PULP	530 tpd
PAPERBOARD	
Linerboard	690 tpd
Containerboard	100 tpd
Total	790 tpd

Irving Pulp & Paper Ltd.

Box 3007, Station B
Saint John, N.B. E2M 3H1
J.K. Irving, president

Financial data not available.

Following acquisition of the St. John, N.B., mill from Kimberly-Clark Corp. early in 1988, Irving announced it would install a 60,000-tpy tissue machine at the mill to bring total capacity to about 75,000 short tpy when the new unit is online in mid-1989.

Production facilities:

SAINT JOHN, N.B.
(Irving Pulp & Paper Ltd.)
Pulp—750 metric tpd bleached and semibleached kraft (for market)

SAINT JOHN, N.B.
(Rothesay Paper Ltd.)
Pulp—525 metric tpd groundwood, 300 tpd thermomechanical
Newsprint—900 metric tpd

SAINT JOHN, N.B.
(Irving Tissue Co., former Kimberly-Clark of Canada mill)
Tissue—40 metric tpd

ST. GEORGE, N.B.
(Lake Utopia Paper Ltd.)
Corrugating medium—225 metric tpd

Total production capacity:

PULP	
Kraft	750 metric tpd
Groundwood	525 metric tpd
TMP	300 metric tpd
Total	1,575 metric tpd
PAPER & BOARD	
Newsprint	900 metric tpd
Tissue	40 metric tpd
Corrugating medium	225 metric tpd
Total	1,165 metric tpd

James River Corp.

Box 2218
Richmond, Va. 23217
Brenton S. Halsey, chairman/chief executive officer

(James River owns 80% of James River-Marathon Ltd.; Buchanan Forest Products Ltd. owns 20%.)

Net sales:	
1988	$5,097,978,000
1987	4,479,001,000
1986	2,606,950,000
1985	2,492,009,000
Net income:	
1988	209,010,000
1987	169,864,000
1986	95,288,000
1985	101,351,000

(fiscal year ends Apr. 30)

James River has become one of the largest manufacturers of paper and paperboard through a series of acquisitions made since its founding in 1969. It has concentrated on buying assets at favorable prices in the higher-valued-added, less cyclical segments of the paper industry. The strategy has worked well, and the company has enjoyed one of the highest returns on capital in the paper industry. Now, however, JR faces the challenge of modernizing many of its older facilities and maintaining its decentralized and entrepreneurial spirit in a large corporate structure. In addition, James River was hurt by rises in pulp prices in 1987. (The company is an estimated net buyer of 600,000 tons of pulp and cuts only about 10% of its needs from its own timber sources).

In fiscal 1986, it acquired seven Crown Zellerbach mills from Sir James Goldsmith and two Premoid mills from Preco Corp.—in addition to beverage service companies, nonwovens businesses, and flexible packaging operations.

At the end of fiscal 1987, JR had 116 manufacturing facilities in U.S., Canada, and U.K. In May of that year, it completed purchase of Dunn Paper Co. from Dennison Manufacturing Corp. In mid-1987, the company expanded into

France with the purchase of 50% (in stages through Jan. 30, 1989) of Béghin-Say's Kaysersberg Div., which makes sanitary papers and nonwovens and later in the year it bought three Wiggins Teape Group mills in U.K. and entered into a nonwovens joint venture with Holmens Bruk AB of Sweden. Early in 1988, James River completed the sale of its Pon Angeles, Wash., mill, acquired with the Crown Zellerbach purchase, to Daishowa America Co.

In the fiscal year ending in April 1987, sanitary paper products sales were $1,260.5 million (28% of total sales), compared with $820.9 million in fiscal year 1986; communication papers, $1,077.6 million (24%), compared with $350.4 million; specialty industrial and packaging papers, $521.3 million (11%), compared with $448.1 million; and paperboard packaging, $366.8 million (8.5%), compared with $367.6 million. JR sells about 250,000 tons of market pulp which accounts for 3% of total sales.

Of total capital expenditures (including acquisitions) of $504.4 million in fiscal 1987, $385.8 million was spent on paper and other products operations. This compares with a corporate figure of $275.4 million and a paper/other products figure of $231.1 million in fiscal 1986.

In early 1987, the Camas, Wash., mill launched a $34 million project to expand bleached kraft pulp capacity to 1,055 tpd by July 1988. Combined with 450 tpd of sulfite pulp, the expansion should eliminate the need to buy pulp.

At the Wauna mill at Clatskanie, Ore., a $31.8 million rebuild of a groundwood specialties paper machine was underway for late 1988 startup. A tissue machine was also being installed at the same mill for 1988 startup.

Two more new tissue machines (cut back from three) will be installed by JR between 1989 and 1994. In fall 1987, JR announced it would enter the carbonless copy paper market, rebuilding a machine at Gorham, N.H., to use technology acquired from Papierfabrik Koehler AG of Fed. Rep. Germany. Output of the new grade will begin in winter 1988.

In spring 1988, JR announced it would build a deinking plant at the Green Bay, Wis., tissue and towel mill.

The Hyde Park, Mass., mill, which was shut down in December 1987, was leased to Nolichucky Industries Corp. in spring 1988. NIC will operate the mill, and it has an option to buy it.

James River acquired 26,000 acres of timberland convenient to the Naheola, Ala., mill in early 1987, with an option to purchase 116,000 additional acres over the next seven years. Company policy, however, is to acquire rights to timber cutting rather than ownership. In all, JR owns, leases, or has cutting rights to about 3.6 million acres of timber.

Production facilities:

Communication Papers Business

NEWARK, DEL.
(Curtis Mills Div.)
Specialty papers—22 tpd

ST. FRANCISVILLE, LA.
(Former Crown Zellerbach mill)
Pulp—633 tpd
Specialty papers—813 tpd
Tissue—8 tpd

ADAMS, MASS.
(Curtis Mills Div.)
Specialty papers—47 tpd

HYDE PARK, MASS.
(Hyde Park Div., being operated by Nolichucky Industries Corp.)
Pulp—60 tpd deinked
Specialty paper—196 tpd

YPSILANTI, MICH.
(Curtis Mills Div.)
Specialty papers—34 tpd

BERLIN, N.H.
(Pulp Div.)
Pulp—1,328 tpd

GORHAM, N.H.
(Paper Div.)
Specialty paper—410 tpd
Tissue—160 tpd

GROVETON, N.H.
Specialty papers—251 tpd
Tissue—5[illegible] tpd

CLATSKANIE, ORE.
(Wauna Mill, formerly Crown Zellerbach)
Pulp—284 tpd
Tissue—248 tpd
Specialty paper—643 tpd

WEST LINN, ORE.
(Former Crown Zellerbach mill)
Pulp—65 tpd
Specialty papers—480 tpd
Tissue—11 tpd

CAMAS, WASH.
(Former Crown Zellerbach mill)
Pulp—1,160 tpd
Tissue—351 tpd
Specialty paper—980 tpd

MARATHON, ONT.
(James River-Marathon Ltd.)
Pulp—500 metric tpd (551 short)

Packaging Business

KALAMAZOO, MICH.
Recycled paperboard—475 tpd

Specialty Papers Business

JAY, MAINE
(James River-Otis Div.)
Specialty paper—120 tpd

EAST PEPPERELL, MASS.
(James River-Pepperell Inc.)
Specialty paper—78 tpd

FITCHBURG, MASS.
(James River-Fitchburg Div.)
Specialty paper—36 tpd

FITCHBURG, MASS.
(James River-Massachusetts Papermaking Div.)
Specialty paper—161 tpd

WEST SPRINGFIELD, MASS.
(Premoid Div.)
Specialty paper—15 tpd

PARCHMENT, MICH.
(KVP Paper Div.)
Specialty papers—407 tpd

PORT HURON, MICH.
(Dunn Paper Div.)
Carbonizing, laminating, lightweight specialties—165 tpd

ROCHESTER, MICH.
(Filtration Products Div.)
Specialty paper—25 tpd

WIGGINS, MISS.
(Dunn Paper Div.)
Carbonizing—55 tpd

MILFORD, N.J.
(Riegel Custom Products Div.)
Specialty paper—154 tpd

HUGHESVILLE, N.J.
(Riegel Custom Products Div.)
Specialty papers—41 tpd

WARREN GLEN, N.J.
(Riegel Packaging Papers Div.)
Specialty paper—70 tpd

BROWNVILLE, N.Y.
(Premoid Div.)
Specialty paper—30 tpd

RICHMOND, VA.
(Filtration Products Div.)
Specialty paper—27 tpd

Towel & Tissue Business

PENNINGTON, ALA.
(Naheola Mill)
Pulp—1,376 tpd kraft
Bleached board—659 tpd
Tissue—628 tpd

OLD TOWN, MAINE
Pulp—1,195
Tissue—212 tpd

BERLIN, N.H.
(Gorham Absorbent Products)
Tissue—162 tpd

CARTHAGE, N.Y.
(Former Crown Zellerbach mill)
Deinked pulp—139 tpd
Tissue—139 tpd

GOUVERNEUR, N.Y.
(Nonwovens Div.)
Tissue—38 tpd

SOUTH GLENS FALLS, N.Y.
(Former Crown Zellerbach mill)
Deinked pulp—183 tpd
Tissue—135 tpd

HALSEY, ORE.
Tissue—270 tpd

ASHLAND, WIS.
Tissue—59 tpd

GREEN BAY, WIS.
Pulp—171 tpd bleached sulfite
Tissue—503 tpd

Total production capacity:

PULP	
Kraft, groundwood	5,592 tpd
Bleached sulfite	171 tpd
Deinked	382 tpd
Total	7,145 tpd

PAPER & BOARD	
Specialty paper	5,259 tpd
Tissue	2,981 tpd
Bleached board	659 tpd
Recycled board	475 tpd
Total	9,374 tpd

Kimberly-Clark Corp.

Box 619100, DFW Airport Station
Dallas, Texas 75261-9100
Darwin E. Smith, chairman/chief executive officer

[Subsidiaries include Kimberly-Clark of Canada Ltd., 100% owned, and Spruce Falls Power & Paper Co. Ltd., 50.5% owned (49.5% by New York Times Co.).]

Net sales:	
1987	$4,884,700,000
1986	4,303,100,000
1985	4,072,900,000
1984	3,616,200,000
Net income:	
1987	325,200,000
1986	269,400,000
1985	267,100,000
1984*	225,000,000

*after $7,400,000 extraordinary gain

Kimberly-Clark manufactures a wide range of products for personal and health care at home and away from home. It also makes technical and specialty papers as well as newsprint and other communication papers. A key strategy is research and development into new technologies and improvement of existing ones, with most of the technologies being based on cellulose formation.

An international company, K-C has subsidiary or equity companies in 20 countries outside the U.S., and its products are sold in about 150 countries.

A significant success for K-C in recent years has been the capture of a major share of the U.S. baby diaper market. In mid-1987, the company's Huggies brand had about 32% of the market vs 52% for rival Procter & Gamble Co.

Sales of tissue, home and hospital health care products, wipes, and related products totaled $3,308.7 million in 1987, printing/writing papers and technical/specialty/industrial papers had sales of $1,000.4 million.

K-C has capacity for 1,230 tpd of tissue in the U.S. and 207 tpd in Canada. Newsprint capacity is 1,232 tpd and 1,130 tpd, respectively. Capacity for other papers is 561 tpd and 58 tpd, respectively.

Capital expenditures in 1987 were $247.3 million, down from $282.4 million in 1986 and $425.8 million in 1985.

K-C expects to spend some $400 to $500 million on capital projects in 1988. Included in this is a $150-million greenfield tissue mill at Jenks, Okla. The 68,000 tpy mill will come on line in mid-1990. K-C also announced plans to install a new 30,000 tpy paper machine at the Whiting, Wis., mill, increasing capacity about 25%. A further development was the sale of the tissue mill at Saint John, N.B., to Irving Pulp & Paper Co.

In spring 1988, the company announced it will spend C$30 million at Terrace Bay, Ont., for environmental control.

K-C owns 480,000 acres of timberland in the U.S. and leases 50,000 more. In Canada, it manages 11,500,000 acres or leases and owns 196,000 acres. The Terrace Bay, Ont., mill is supported by 7.6 million acres of forestland; Spruce Falls is supported by 4.2 million acres.

Production facilities:

COOSA PINES, ALA.
(Coosa River Newsprint)
Pulp—1,200 tpd kraft; 775 tpd groundwood; 120 tpd thermomechanical
Newsprint, groundwood printing paper—1,230 tpd

FULLERTON, CALIF.
Tissue, cellulose wadding—185 tpd

NEW MILFORD, CONN.
Tissue, towels—200 tpd

LEE, MASS.
Cigarette, lightweight specialties—85 tpd

MUNISING, MICH.
(Technical Paper)
Writing, map, specialties—100 tpd

SPOTSWOOD, N.J.
Cigarette plug wrap—130 tpd

ANCRAM, N.Y.
Cigarette plug wrap, technical specialties—15 tpd

BEECH ISLAND, S.C.
Tissue, wadding, towels—270 tpd

MEMPHIS, TENN.
Tissue, wadding, towels—310 tpd

NEENAH, WIS.
(Neenah Paper)
Tissue, wadding, towels—275 tpd

NEENAH, WIS.
Wadding, industrial wipers—60 tpd

WHITING (Stevens Point), WIS.
(Neenah Paper)
Bond, cover, text paper—40 tpd

HUNTSVILLE, ONT.
(Kimberly-Clark of Canada)
Wadding—100 metric tpd (110 short)

KAPUSKASING, ONT.
(Spruce Falls Power & Paper Co. Ltd.)
Pulp—635 metric tpd (700 short) groundwood (K-C's share: 354 short tpd); 381 metric tpd (420 short) thermomechanical (K-C's share: 212 short tpd); 181 metric tpd (200 short) magnefite (K-C's share: 101 short tpd)
Newsprint, groundwood printing—1,025 metric tpd (1,130 short) (K-C's share: 571 short tpd)

ST. CATHARINES, ONT.
(Kimberly-Clark of Canada)
Specialty tissue, lightweight—104 metric tpd (115 short)

TERRACE BAY, ONT.
(Kimberly-Clark of Canada)
Pulp—1,135 metric tpd (1,251 short) bleached kraft (some for market)

Total production capacity:

PULP (short tons)	
Kraft	2,354 tpd
Magnefite	111 tpd
Groundwood	1,165 tpd
TMP	321 tpd
Total	4,013 tpd

PAPER (short tons)	
Newsprint/groundwood specialty	1,801 tpd
Tissue	1,315 tpd
Printing/writing, specialty	254 tpd
Cigarette	230 tpd
Technical	100 tpd
Total	3,700 tpd

Kruger Inc.

3285 Bedford Rd.
Montreal, Que. H3S 1G5
R. Joseph Kneeland, president/chief executive officer
Financial data not available. All sales are derived from paper products.

Kruger is Canada's largest privately owned company in the industry. In 1984, Kruger purchased Bowater Inc.'s Corner Brook, Nfld., mill and began a five-year, C$250-million improvement program.

By early 1987, Kruger had completed the rebuild of three machines and planned a fourth for completion in 1988. Plans call for installation of two more thermomechanical pulping lines by 1989, completing the program. No. 7 newsprint machine, which has been idle, will be rebuilt in 1988. No. 3 will be idled at that time. Mill capacity will be increased by 200 metric tpd to 1,000 metric tpd. In spring 1988, Kruger announced it would install the 180,000-metric-tpy newsprint machine it has had in storage for several years at Trois Rivières, Que., constructing a building to house No. 10 and completing the project in late 1989 or early 1990. There may be some changes made to the present machines, possibly converting one or two to make SC-B.

Kruger was the first mill to offer newsprint for flexographic printing on a commercial basis.

Production facilities:

CORNER BROOK, Nfld.
Pulp—590 metric tpd groundwood; 544 metric tpd thermomechanical
Newsprint—850 metric tpd

BROMPTONVILLE, QUE.
(Newsprint Div.)
Pulp—680 metric tpd thermomechanical
Newsprint—580 metric tpd

MONTREAL, QUE.
(Turcot Paperboard Div.)
Recycled paperboard—272 metric tpd

TROIS RIVIERES, QUE.
Pulp—517 metric tpd groundwood; 325 metric tpd thermomechanical
Newsprint—726 metric tpd
Coated publication paper—363 metric tpd

Total production capacity:

PULP	
Groundwood	1,107 metric tpd
TMP	1,549 metric tpd
Total	2,656 metric tpd

PAPER & BOARD	
Newsprint	2,156 metric tpd
Coated publication	363 metric tpd
Paperboard	272 metric tpd
Total	2,791 metric tpd

Longview Fibre Co.

Box 639
Longview, Wash. 98632
R.P. Wollenberg,
chairman/president/chief executive officer

Net sales:	
1987	$569,399,000
1986	487,685,000
1985	459,058,000
1984	483,005,000
Net income:	
1987	65,166,000
1986	33,484,000
1985	22,418,000
1984	22,183,000

(fiscal year ends Oct. 31)

Longview Fibre specializes in kraft linerboard and kraft packaging paper at its big Longview, Wash., mill. About 61% of this output goes to the company's 14 converting plants in nine states. Almost 90% of Longview's sales in fiscal 1987 were derived from pulp, paperboard, and converting operations—about 52% from converting.

Output of paper and paperboard in 1986 was 805,000 tons.

Sales of paper and board in 1987 reached $215 million ($182 million in 1986), and converted products sales were $295 million ($248 million in 1986).

In 1987, 276,000 tons of paper were produced (266,000 tons in 1986), 174,000 tons of paperboard (138,000 tons in 1986), and 518,000 tons of converted products (455,000 tons in 1986).

Capital expenditures in 1986 were $25,129,000, and $65,346,000 was spent in fiscal 1987, including a new press section for No. 5 kraft paper machine. The company will install a second continuous pulp digester in a $57-million investment, adding 1,150 tpd to capacity and making the total 3,000 tpd at the mill. Startup is set for August 1988. Total fiscal 1988 investments are budgeted at $70 million.

Longview's timberland resources include 516,000 acres owned and cutting rights on 15,000 acres controlled.

Production facilities:

LONGVIEW, WASH.
Pulp—2,760 tpd kraft; 240 tpd semichemical
Packaging, industrial converting paper—1,335 tpd
Unbleached kraft board—1,265 tpd
Semichemical board—200 tpd

Total production capacity:

PULP	
Kraft	2,760 tpd
Semichemical	240 tpd
Total	3,000 tpd

PAPER & BOARD	
Packaging/industrial converting paper	1,335 tpd
Unbleached kraft board	1,265 tpd
Semichemical board	200 tpd
Total	2,800 tpd

Louisiana-Pacific Corp.

111 S.W. Fifth Ave.
Portland, Ore. 97204
Harry A. Merlo, chairman/president

Net sales:	
1987	$1,921,600,000
1986	1,506,200,000
1985	1,260,920,000
1984	1,230,040,000
Net income:	
1987	125,000,000
1986	64,900,000
1985	25,500,000
1984	42,150,000

Louisiana-Pacific is a major U.S. forest products company with more than 120 building materials plants. The pulp, paperboard, and containerboard sector accounted for 11% of total sales in 1986.

In fall 1987, L-P announced that it would spin off the Fibreboard Corp. subsidiary in 1988. (Earlier in the year, L-P had been close to selling the Antioch, Calif., mill to the U.S. subsidiary of Daishowa Paper Co. Ltd.) The reason for the spinoff appears to be to reduce liability to asbestos claims against Fibreboard. The Container Products Div. of Fibreboard was on the market at the end of 1987, and Gaylord Container Corp. completed acquisition of the Antioch mill, plus other assets, by April 1988. L-P will receive $440 million plus interest from a lawsuit related to timberland takeover by the federal government to create Redwood National Park.

Sales of pulp, paperboard, and containers in 1987 were $304 million, up from $231 million in 1986. Operating profits were $57 million, up from $15.8 million in 1986.

Capital expenditures in 1987 were $23 million for pulp, paperboard, and containers ($17 million in 1986).

In late 1987, L-P announced a $70-million project to increase capacity at Samoa, Calif., by 15% and improve air and water quality. An oxygen delignification system will be part of the package.

L-P's timberlands include 1,600,000 acres owned and 790,000 acres controlled.

Production facilities:

KETCHIKAN, ALASKA
Pulp—600 tpd dissolving sulfite (for market)

SAMOA, CALIF.
Pulp—600 tpd bleached kraft (for market)

Total production capacity:

PULP	
Sulfite	600 tpd
Kraft	600 tpd
Total	1,200 tpd

MacMillan Bloedel Ltd.

1075 W. Georgia St.
Vancouver, B.C. V6E 3R9
R.V. Smith, president/chief executive officer

(MB is 49.9% owned by Noranda Forest Inc. It has a 50% interest in Island Paper Mills Ltd.; Fraser has the other 50%.)

Net sales (C$)	
1987	$3,134,500,000
1986	2,511,700,000
1985	2,335,400,000
1984	2,127,600,000
Net earnings (C$)	
1987	280,600,000
1986	178,300,000
1985	32,800,000
1984	32,300,000

MacMillan Bloedel is Canada's largest forest products company with integrated operations in Canada, U.S., U.K., and continental Europe. Its products are kraft pulp, newsprint, groundwood printing papers, fine papers, containerboard, and corrugated containers. The company has been emphasizing a program to reduce costs and stress new, value-added products, including groundwood papers and higher-quality newsprint.

Sales of pulp and paper reached $1,145.3 million in 1987, with newsprint contributing C$734.9 million; market pulp, $364.2 million; fine papers, $9.4 million; and recycled fiber, $36.8 million. Containerboard contributed $246.1 million to sales.

In 1987, MB produced 482,000 metric tons of market pulp, 353,000 tons of newsprint, 594,000 tons of groundwood printing papers, 387,000 tons of linerboard, and 294,000 tons of corrugating medium.

Total capital expenditures in 1987 were C$256.6 million, of which $122.6 million (37.6%) was for pulp and paper and $19.5 million (25.1%) was for containerboard and packaging. Pulp and paper expenditures jumped from $32.1 million in 1986, and containerboard/packaging increased modestly from $14.3 million in 1986.

At Powell River, B.C., a C$70-million four-part project raised newsprint and groundwood specialty paper capacity by 35,000 metric tpy to 625,000 tpy. A C$60-million upgrade to No. 8 newsprint machine at this mill brought online a machine that had been idle since 1985. At Port Alberni, B.C., MB spent C$8 million to modernize No. 4 lightweight groundwood and specialty newsprint machine to produce color specialty newsprint and directory papers; startup was set for mid-1988. At the same mill, a rebuild of No. 5 newsprint machine was expected to be completed in early 1988. About the same time, MB announced it would build a C$95-million chemi-thermomechanical pulp line at Port Alberni, with capacity for about 350 metric tpd. Startup of the line, set for fall 1989, will enable the mill to reduce its semibleached kraft pulp output from 350 tpd to about 250 tpd, and allow the shutdown of an old refiner groundwood mill.

MB owns 560,690 acres of timberland in Canada and has cutting rights on 2,823,210 additional acres; it owns 153,140 acres in the U.S. and has cutting rights on 256,880 acres.

Production facilities:

NANAIMO, B.C.
(Harmac Div.)
Pulp—1,015 metric tpd bleached kraft (for market)

NEW WESTMINSTER, B.C.
(Island Paper Mills Ltd., jointly owned)
Uncoated free-sheet—410 metric tpd (MB's share: 205 tpd)

PORT ALBERNI, B.C.
(Alberni Pulp & Paper Div.)
Pulp—500 metric tpd unbleached kraft (200 for market); 300 metric tpd bleached kraft; 620 metric tpd groundwood; 75 metric tpd refiner groundwood
Newsprint and/or groundwood specialty—1,090 metric tpd

POWELL RIVER, B.C.
(Powell River Div.)
Pulp—455 metric tpd kraft (90 tpd for market); 700 metric tpd groundwood; 635 metric tpd chemi-thermomechanical
Newsprint/groundwood paper—1,750 metric tpd

STURGEON FALLS, ONT.
Pulp—250 metric tpd semichemical
Corrugating medium—210 metric tpd

PINE HILL, ALA.
(MacMillan Bloedel Inc.)
Pulp—1,100 short tpd (1,000 metric) unbleached kraft; 430 short tpd (390 metric) semichemical
Linerboard—1,165 short tpd (1,055 metric)
Corrugating medium—650 short tpd (590 metric)

Total production capacity:

PULP	
Kraft	3,270 metric tpd
Semichemical	640 metric tpd
Groundwood/RMP	1,395 metric tpd
CTMP	635 metric tpd
Total	5,940 metric tpd

PAPER & BOARD	
Newsprint/groundwood specialty	2,840 metric tpd
Uncoated free-sheet	205 metric tpd
Linerboard	1,055 metric tpd
Corrugating medium	800 metric tpd
Total	4,900 metric tpd

Manville Forest Products Corp.

(Sub. of Manville Corp.)
Box 488
West Monroe, La. 71294-0488
H.W. Sherman, president

Financial data not available.

Manville Corp. filed for protection under Chapter 11 of the federal bankruptcy code in mid-1982. It was expecting to emerge from bankruptcy in the first half of 1988.

The West Monroe, La., mill has five machines: three manufacturing on-machine clay-coated boards, one making corrugating medium, and one making kraft bag paper. The West Monroe mill (which Manville acquired from Olinkraft Inc. in 1978) was a pioneer in developing clay-coated kraft board (solid unbleached sulfate) grades used in beverage carriers and folding cartons. Capacity at the end of 1987 was about 600,000 tpy.

A $32-million modernization/rebuild of No. 6 machine increased capacity by 100,000 tpy to a total of 550,000 tpy. By 1990, the machine is expected to produce 1,000 tpd. In late 1987, the company announced that it would rebuild No. 4 machine, which has not been in operation since 1982.

Production facilities:

WEST MONROE, LA
Pulp—1,700 tpd kraft; 270 tpd semichemical
Kraft paper—125 tpd
Paperboard—1,560 tpd
Corrugating medium—300 tpd

Total production capacity:

PULP	
Kraft	1,700 tpd
Semichemical	270 tpd
Total	1,970 tpd
PAPER & BOARD	
Paperboard	1,560 tpd
Kraft paper	125 tpd
Corrugating medium	300 tpd
Total	1,985 tpd

Macon Kraft Inc.

Box 1551
Rome, Ga. 30161
Timothy L. Campbell, president/chief executive officer

Financial data not available.

In 1987, Pratt Holdings Pty Ltd. of Australia acquired Georgia Kraft Co.'s Macon, Ga., mill from joint owners Mead Corp. and Temple-Inland Inc. A large lumber/plywood manufacturing complex and 200,000 acres of timberland were included in the purchase, but Pratt said it would sell the woodlands and wood products complex to Georgia-Pacific Corp.

The new owner announced plans in late 1987 to invest about $170 million in the mill, spread over several years.

Production facilities:

MACON (Krannert), GA
Kraft linerboard—1,500 tpd

Total production capacity:

PAPERBOARD	1,500 tpd

Mead Corp.

Courthouse Plaza Northeast
Dayton, Ohio 45463
Burnell R. Roberts, chairman/chief executive officer

[Mead has a 50% interest in Northwood Forest Industries (with Noranda Forest Inc.) and recently sold its 50% interest (with Scott Paper Co.) in Brunswick Pulp & Paper Co.]

Net sales:	
1987	$4,208,800,000
1986	3,217,700,000
1985	2,740,400,000
1984	2,720,200,000
Net earnings:	
1987	216,700,000
1986	36,300,000
1985	93,500,000
1984	139,200,000

Mead segments include paper, packaging and paperboard, pulp and wood products, converted paper products, distribution, and electronic publishing. The main emphasis, however, is on coated paper and paperboard, and the company has recently divested a number of operations that no longer fit its strategic plan. The purchase of Zellerbach Distribution Group in May 1986 made Mead the largest U.S. integrated distributor of paper. The acquisition of Ampad Corp. in November of that year added to the company's line of converted products. Sixty-one percent of total sales are derived from pulp, paper, paperboard, and converting operations.

Mead sold its 50% interest in Schoeller Technical Papers Inc. in February 1986 to Felix Schoeller GmbH, but it has full ownership of Schoeller Release Products Co., renamed Mead Release Products.

In May 1986, Mead sold its 15% direct interest in British Columbia Forest Products. Brunswick Pulp & Paper also sold its share in BCFP.

In early 1987, Mead announced plans to terminate its joint ventures with Scott Paper Co. and Temple-Inland Inc. In mid-1987, Mead and Temple-Inland Inc. completed the sale of the Macon, Ga., mill of Georgia Kraft Co. to an Australian firm, Pratt Holdings Pty Ltd. Mead retained the Phenix City (Mahrt), Ala., mill and the Rome (Temple), Ga., mill of the Georgia Kraft trio. Mead also sold six corrugated box plants to Weyerhaeuser Co. in 1987, but retained eight plants and its Stevenson, Ala., semichemical medium mill.

In fall 1987, Mead announced it would sell its recycled paperboard mills at Otsego, Mich.; Cincinnati, Ohio; and Lynchburg, Va., to Rock-Tenn Co. In mid-1988, Mead and Scott sold Brunswick Pulp & Paper to Georgia-Pacific Corp.

In spring 1988, Mead began construction of a new 350,000-tpy coated natural kraft board mill at Mahrt, Ala., adjacent to its Georgia Kraft mill. The greenfield mill, for 1991 startup, will nearly double current capacity for 430,000 tpy of coated paperboard. The $500-million project, the largest Mead has undertaken, will be completed in 1991.

Sales of paper in 1987 were $1,176.4 million, up from $1,103.6 million in 1986. Packaging and paperboard sales in 1987 were $1,010.1, up from $924.9 million in 1986. And pulp sales were $97.3 million, up from $72.1 million in 1986.

Paper output in 1987 was 1.185 million tons, up from 1.173 million tons in 1986. However, paperboard production dropped to 1.549 million tons from 1.682 million tons. Pulp output in 1987 was 468,000 tons, compared with 455,000 tons in 1986.

Capital expenditures totaled $175.3 million in 1987; of this, $71.1 million went for paper projects, $27.4 million for packaging and paperboard, and $4.5 million for pulp improvements. Expenditures in 1986 were $177 million.

Projects in 1987 included a $17-million rebuild of a paper machine and coater at Escanaba, Mich., and an $11-million machine rebuild at Chillicothe, Ohio. In the fall of 1987, Mead announced a project, still in preliminary stages though scheduled for 1991 startup, which would add about 350,000 tpy of coated natural kraft paperboard capacity, making the company the No. 1 producer of this grade. The proposed site for the $500 million project is adjacent to the existing mill at Mahrt.

Mead owns 1,638,000 acres of timberland and controls 151,000 additional acres. Pratt received about 200,000 acres with the purchase of the Macon mill, and the remaining Georgia Kraft acreage was split between Mead and Temple-Inland.

Production facilities:

PHENIX CITY (Mahrt), ALA.
(Alabama Kraft Co.)
Pulp—1,000 tpd kraft
Kraft packaging—1,100 tpd

STEVENSON, ALA.
(Alabama Kraft Co.—Paperboard Div.)
Pulp—600 tpd semichemical
Corrugating medium—945 tpd

SOUTH LEE, MASS.
(Specialty Paper Div.)
Specialty paper—70 tpd

ESCANABA, MICH.
(Publishing Paper Div.)
Pulp—600 tpd kraft (300 tpd for market); 200 tpd groundwood
Printing/writing paper—1,300 tpd

CHILLICOTHE, OHIO
(Chillicothe Div.)
Pulp—600 tpd kraft
Coated, carbonless paper—700 tpd

CHILLICOTHE, OHIO
(Chilpaco Mill)
Book, specialty—475 tpd

KINGSPORT, TENN.
(Fine Paper Div.)
Pulp—250 tpd soda
Coated, uncoated paper—550 tpd

MENASHA, WIS.
(Gilbert Paper Co.)
Rag-content, security paper—100 tpd

PRINCE GEORGE, B.C.
(Northwood Forest Industries)
Kraft pulp—1,450 metric tpd (1,600 short) kraft (Mead's share 800 short tpd)

Total production capacity:

PULP (short tons)	
Kraft	3,900 tpd
Soda	265 tpd
Semichemical	600 tpd
Groundwood	200 tpd
Total	4,965 tpd
PAPER (short tons)	
Printing/writing	3,025 tpd
Rag-content	100 tpd
Specialty	70 tpd
Total	3,195 tpd
PAPERBOARD (short tons)	
Corrugating medium	945 tpd
Natural kraft	1,100 tpd
Bleached board	265 tpd
Total	2,310 tpd
TOTAL PAPER & BOARD	5,505 tpd

National Gypsum Co.

4500 Lincoln Plaza
Dallas, Texas 75201-3319
J.P. Hayes, chairman/chief executive officer

Financial data not available.

Gypsum board liner and chipboard are produced by National Gypsum's Gold Bond Building Products Div.

Production facilities:

ANNISTON, ALA.
Gypsum board liner—208 tpd

STOCKTON, CALIF.
Gypsum board liner—162 tpd
Chipboard—115 tpd

PRYOR, OKLA.
Gypsum board liner—217 tpd

MILTON, PA.
Gypsum board liner—325 tpd

Total production capacity:

PAPERBOARD	
Gypsum board liner	912 tpd
Chipboard	115 tpd
Total	1,027 tpd

Newark Boxboard Co.

(Sub. of The Newark Group Inc.)
57 Freeman St.
Newark, N.J. 07105
Edward K. Mullen, chairman/chief executive officer

(Atlantic Coast Paperboard Corp., California Paperboard Corp., Franklin Boxboard Corp., and Mobile Paperboard Corp. are subsidiaries of Newark Boxboard. Haverhill Paperboard Co., Middletown Paperboard Co., Natick Paperboard Co., and Wisconsin Paperboard Corp. are divisions of Newark Boxboard.)

Financial data not available.

The company is the second largest U.S. recycled paperboard producer with an expanding roster of mills. In 1984, Newark acquired the Lawrence, Mass., mill from bankrupt Lawrence Paperboard Corp., thus entering the clay-coated folding carton market. The same year, the company traded its Uncasville, Conn., recycled medium mill for Stone Container's recycled boxboard mills in Franklin, Ohio, and Mobile, Ala.

Production facilities:

MOBILE, ALA.
(Mobile Paperboard Corp.)
Recycled boxboard—180 tpd

SANTA CLARA, CALIF.
(California Paperboard Corp.)
Recycled paperboard—210 tpd

HAVERHILL, MASS.
(Haverhill Paperboard Co.)
Recycled paperboard—300 tpd

LAWRENCE, MASS.
(Atlantic Coast Paperboard Inc., formerly Lawrence Paperboard Corp. mill)
Recycled paperboard—200 tpd

NATICK, MASS.
(Natick Paperboard Co.)
Recycled paperboard—100 tpd

NEWARK, N.J.
(Newark Mill)
Recycled paperboard—120 tpd

FRANKLIN, OHIO
(Franklin Boxboard Corp.)
Recycled boxboard—165 tpd

MIDDLETOWN, OHIO
(Middletown Paperboard Co.)
Recycled paperboard—120 tpd

MILWAUKEE, WIS.
(Wisconsin Paperboard Corp.)
Recycled paperboard—400 tpd

Total production capacity:

PAPERBOARD	1,795 tpd

Noranda Forest Inc.

(Sub. of Noranda Inc.)
4 King St. W., Suite 800
Toronto, Ont. M5H 3X1
A.H. Zimmerman, chairman/chief executive officer

[Noranda Forest Inc. owns 100% of Fraser Inc. and James Maclaren Industries, 75% of Island Paper Mills Ltd. (50% through Fraser and 25% through MacMillan Bloedel), 50% of Northwood Pulp & Timber Ltd., and 49.9% of MacMillan Bloedel Ltd. (over which it has voting control; MacMillan Bloedel is listed separately in Profiles). Fraser owns 100% of Atholville Pulp Inc. Noranda has a 24% interest in Normick Perron Inc., which in turn has a 42% interest in the Donohue-Normick Inc. joint-venture newsprint mill at Amos, Que.]

Noranda Forest Inc.	
Net sales (C$)	
1987	$4,246,500,000
1986	3,563,900,000
1985	3,517,000,000
1984	2,791,400,000
Net earnings (C$)	
1987	203,200,000
1986	102,700,000
1985	50,600,000
1984	137,400,000

Fraser Inc.	
Net sales (C$)	
1986	$586,738,000
1985	548,304,000
1984	529,538,000
Net earnings	
1986	20,581,000
1985	–15,700,000
1984	3,487,000

Noranda Inc. established its Noranda Forest Inc. subsidiary in 1987 with the amalgamation of Fraser and James Maclaren Industries, following which the shares in MacMillan Bloedel, Northwood, and Noranda Forest Sales were transferred to the company, now freestanding.

Forty-seven percent of net sales of $1.97 million in 1987 came from pulp and paper, and 12% came from paperboard.

Total pulp and paper production in 1987 was 2.8 million metric tons (including Northwood and excluding own use of pulp), with pulp contributing 38%; newsprint, 26%; groundwood paper, 24%; and free-sheet, 12%.

Noranda (including MacMillan Bloedel) has capacity for 1,236,000 metric tpy of pulp, 1,143,000 tons of newsprint (including MacMillan Bloedel groundwood), 231,000 tons of groundwood, and 362,000 tons of free-sheet. Production in 1987 was 1,191,000 metric tons of pulp, 1,127,000 tons of newsprint, 231,000 tons of groundwood, and 341,000 tons of free-sheet.

Since 1982, Noranda Forests has spent C$1.182 million on capital outlays, $651.7 million of it for pulp and paper projects. About half of the total went for new facilities or modernization of existing ones. In 1987, this sector took 53% of a total C$326 million ($146 million in 1986). Paperboard packaging spent 6% of the 1987 total.

Pulp output by Fraser Inc. in 1986 was 501,754 metric tons. Newsprint production reached 65,286 metric tons in 1986. Fraser spent $28.4 million on capital expenditures in 1986, up from $22.6 million in 1985. The small Atholville, N.B., bisulfite pulp mill was substantially modernized in the early 1980s at a cost of C$230 million. A $53.5-million modernization project at Madawaska, Maine, began in spring 1988, with paper machine Nos. 1, 4, and 5 being upgraded.

James Maclaren had sales of C$196.3 million in 1986, with earnings of $32.9 million. It produced 128,000 metric tpy of market pulp in 1986, up from 96,000 tons in 1985, and it produced 136,000 metric tons of newsprint, up from 114,000 tons in 1985. Fully operational in 1986 was the new, $117-million machine which replaced two old newsprint units at Masson, Que. JM spent C$13.9 million in 1986 on capital expenditures.

Northwood Pulp and Timber had net earnings of C$22.8 million in 1986 on sales of $421.2 million. It produced 446,000 metric tons of market pulp in 1986, up from 389,000 tons in 1985. Capital expenditures were C$9.4 million in 1986. Its Prince George, B.C., pulp mill was doubled in size in 1982.

Noranda owns 1,542,000 acres of timber and has cutting rights on another 6,625,000 acres in Canada. Fraser holdings are 766,000 acres of timberland owned in Canada and 1,107,000 acres controlled under Crown license.

Production facilities:

Fraser Inc.

NEW WESTMINSTER, B.C.
(Island Paper Mills Ltd.)
Fine paper—410 metric tpd (Fraser's share: 205 tpd)

ATHOLVILLE, N.B.
(Atholville Pulp Inc.)
Pulp—325 metric tpd magnesium bisulfite (for market)

EDMUNDSTON, N.B.
(Fraser Boxboard)
Pulp—350 metric tpd groundwood; 400 metric tpd bleached softwood sulfite; 200 metric tpd unbleached and semi-bleached sulfite
Paperboard—95 metric tpd coated and uncoated boxboard

THOROLD, ONT.
(Thorold Div.)
Pulp—100 metric tpd deinked
Coated and uncoated free-sheet—275 metric tpd

MADAWASKA, MAINE
(Fraser Paper Ltd.)
Uncoated groundwood paper—360 short tpd (330 metric)
Uncoated free-sheet—4[illegible] short tpd (390 metric)
Coated paper—440 short tpd (400 metric)

James Maclaren Industries Inc.

MASSON (Buckingham), QUE.
Pulp—380 metric tpd groundwood; 145 metric tpd sulfite
Newsprint—445 metric tpd

THURSO, QUE.
Pulp—330 metric tpd bleached kraft (for market)

Northwood Pulp & Timber

PRINCE GEORGE, B.C.
Pulp—1,426 metric tpd bleached kraft (1,050 for market) (Noranda's share: 715 metric tpd)

Total production capacity:

PULP	
Kraft	1,045 metric tpd
Sulfite	1,070 tpd
Groundwood	730 metric tpd
Deinked	100 metric tpd
Total	2,945 metric tpd
PAPER & BOARD	
Fine paper	205 metric tpd
Newsprint	445 metric tpd
Printing/writing	1,395 metric tpd
Paperboard	95 metric tpd
Total	2,140 metric tpd

Packaging Corp. of America

(Sub. of Tenneco Inc.)
1603 Orrington Ave.
Evanston, Ill. 60204
Monte R. Haymon, president/chief executive officer

Net sales:	
1987	+$1,000,000,000
1986	955,000,000
1985	854,500,000
1984	799,500,000

Operating income:	
1987	166,000,000
1986 est.	110,000,000
1985	93,000,000
1984	85,600,000

Packaging Corp. made several specialty packaging acquisitions in 1986 to implement its drive to become a full-line packaging company. In 1987, a deal fell through to sell the Rittman, Ohio, and Tama, Iowa, mills to Republic Gypsum Co., but the mills remained for sale.

PCA has capacity to produce almost one million tpy of containerboard at its big Counce, Tenn., and Filer City, Mich., mills. Much of this production is converted at the company's 25 U.S. box plants. The Molded Fibre Div. operates four plants in the U.S. and two in Europe producing egg, produce, and other special trays. In addition, the Disposable Packaging Div. produces containers from a wide variety of materials, including aluminum, paperboard, and plastics.

The company was headed toward its fourth consecutive year of record profits in 1987. To increase capacity and improve quality, the company installed one Extended-Nip Press at its Counce, Tenn., mill and had plans to add another to the second machine.

Pulp, paper, paperboard, and converting operations accounted for sales of $786 million in 1986, up from $761 million in 1985. Shipments (to outside customers only) of paper and board were 818,000 tons in 1986, an increase from 742,073 tons shipped in 1985. An additional 11.2 million ft^2 of converted products were shipped in 1986; 10 million ft^2 were shipped in 1985.

PCA manages 450,000 acres of forest.

Production facilities:

RED BLUFF, CALIF.
Molded pulp products

MACON, GA.
Molded pulp products—88 tpd

GRIFFITH, IND.
Molded pulp products—82 tpd

TAMA, IOWA
Recycled board—105 tpd

FILER CITY, MICH.
Pulp—610 tpd semichemical
Corrugating medium—720 tpd

NATCHEZ, MISS.
(Mill idle)
Molded pulp products

PLATTSBURGH, N.Y.
Molded pulp products

RITTMAN, OHIO
Recycled board—465 tpd

COUNCE, TENN
(Tennessee River Pulp & Paper Co.)
Pulp—1,600 tpd kraft
Linerboard—1,900 tpd

Total production capacity:

PULP	
Kraft	1,600 tpd
Semichemical	610 tpd
Total	2,210 tpd
PAPERBOARD	
Recycled board	570 tpd
Corrugating medium	720 tpd
Linerboard	1,900 tpd
Total	3,190 tpd

Paperboard Industries Corp.

144 Front St. West, Suite 600
Toronto, Ont. M5J 1G2
C. Ian Ross, president, chief executive officer

(Kinburn Industrial Corp. owns 98% of PIC. The last shares of Belkin Inc. were acquired in August 1987 and amalgamated into PIC in September of that year.)

Paperboard Industries Corp.

Net sales (C$):	
1987*	$203,749,000
1986	79,792,000
1985	71,563,000
1984	67,216,000
Net earnings (C$):	
1987*	3,012,000
1986	3,228,000
1985	569,000
1984	405,000

(fiscal year ends Aug. 31)
*Includes three months of Belkin Inc. operations

Belkin Inc.

Net sales (C$):	
1986	$382,875,000
1985	367,139,000
1984	323,789,000
Net income (C$):	
1986	13,282,000
1985	10,059,000
1984	9,410,000

(fiscal year ends Sept. 30)

PIC was incorporated in 1980; in 1982, it brought together its four companies, Trent Valley Paperboard Mills being the oldest and the only paperboard manufacturer; and in 1984, PIC was organized into one legal entity. In 1986, the U.S. subsidiary, Paperboard Industries Inc., bought Big M Paperboard Inc. of Palmyra, Mich., which has boxboard capacity of 25,000 metric tpy and is strategically close to the Trent Valley operation. With the Belkin acquisition, PIC became a significant factor in collecting wastepaper, in manufacturing recycled paperboard, and in converting and selling packaging products.

The Trent Valley operation consists of East Mill, over a century old, which produces boxboard on two machines, and West Mill, which dates from 1978 and makes either boxboard or linerboard on one machine. Capital expenditures of C$1.5 million from 1984 through 1986 brought capacity to 110,000 metric tpy.

Belkin Inc. was a fully integrated paperboard and packaging manufacturing operation formed in late 1985 by the amalgamation of Kevcorp Industries Ltd., Belkin Packaging Ltd., and Pioneer Envelopes Ltd. A wholly owned subsidiary, Somerville Packaging, is a Canadian leader in paperboard packaging. Belkin was one of Canada's leading producers of boxboard and a large consumer of recycled paperstock. It produced 292,000 tons of paperboard in 1986.

Capacity of the Burnaby, B.C., mill is 136,000 metric tpy of containerboard, clay-coated boxboard, and roofing felt. Capacity of the Toronto, Ont., mill is 136,000 metric tpy of coated linerboard and boxboard. The Montreal, Que., mill has capacity for 34,000 metric tpy of box partitions, uncoated boxboard, and corestock.

Production facilities:

BURNABY, B.C.
(Former Belkin Inc. mill)
Paperboard—550 metric tpd containerboard, boxboard

TORONTO, ONT.
(Former Belkin Inc. mill)
Paperboard—410 metric tpd coated linerboard, boxboard

TRENTON (Glen Miller), ONT.
(Trent Valley Div., West and East mills)
Paperboard—330 metric tpd boxboard or linerboard

MONTREAL, QUE.
(Former Belkin Inc. mill)
Paperboard—100 metric tpd boxboard, corestock

PALMYRA, MICH.
(Big M Paperboard Inc.)
Recycled paperboard—83 short tpd (75 metric)

Total production capacity:

PAPERBOARD	1,465 metric tpd

Parsons & Whittemore Inc.

666 Third Ave.
New York, N.Y. 10017
Arthur Schwartz, president

Financial data not available.

P&W is one of the largest privately owned companies in the North American pulp and paper industry. The company was believed to have entered a difficult financial period following the 1984-85 industry downturn, and there were rumors that at least one of its large pulp mills might be sold. The company's condition, however, probably strengthened with the recovery in pulp prices, and there has been no further discussion of possible asset sales.

In spring 1988, P&W and Abitibi-Price Inc. announced plans to build jointly a 220,000-metric tpy newsprint mill near P&W's Alabama River Pulp Co. mill. P&W would be responsible for design and construction of the mill, and Abitibi would operate it. In preparation for the new mill, P&W is spending $35 million in a three-year program to add 30,000 metric tpy of bleached kraft pulp capacity.

Production facilities:

CLAIBORNE, ALA.
(Alabama River Pulp Co.)
Pulp—1,100 tpd bleached hardwood and softwood kraft (for market)

NACKAWIC, N.B.
(St. Anne-Nackawic Pulp & Paper Co. Ltd.)
Pulp—675 metric tpd (744 short) bleached hardwood kraft (for market)

Total production capacity:

PULP	1,844 short tpd

Pentair Inc.

1700 W. Highway 36
St. Paul, Minn. 55113
D. Eugene Nugent, president/chief executive officer

(Wholly owned subsidiaries are Niagara of Wisconsin Paper Corp., Miami Paper Corp., and Flambeau Paper Corp. Port Huron Paper Corp.'s two mills have been sold. Lake Superior Paper Industries is a 50-50 joint venture with Minnesota Power.)

Net sales:	
1987	$789,245,000
1986	623,876,000
1985	534,198,000
1984	545,438,000

Net income:	
1987	21,860,000
1986	15,228,000
1985	20,058,000
1984	21,245,000

Net sales, paper sector:	
1987	$387,000,000
1986	377,800,000
1985	363,600,000
1984	389,600,000

Operating income, paper sector:	
1987	9,000,000
1986	18,400,000
1985	22,800,000
1984	37,300,000

Pentair, formed in 1966, has grown through acquisitions. In 1978, the company began to diversify, and by 1986, approximately half of total revenues were from the Industrial Products Group. Pentair is seeking a balance between this group and the paper sector. The $415-million Lake Superior Paper Industries mill, for which ground was broken in April 1986 in Duluth, Minn., and which came online in late 1987, was the first mill Pentair had been involved in building. The 250,000-tpy joint venture by Pentair Duluth Corp. (subsidiary of Pentair Inc.) and Minnesota Paper Inc. (subsidiary of Minnesota Power) gave Pentair entrance into the supercalendered paper market. In spring 1988, Pentair announced it would combine Flambeau and Miami for efficiency and possibility of product development. A new name will be given to the combined operation.

Paper accounted for 39% of net sales in 1987. Of this, 28% was for commercial printing, 24% each for premium printing/specialty and magazines/catalogs/inserts, 15% for books, and 9% for business.

The company spent $26.5 million in 1986 on capital projects for paper operations from a corporate total of $35 million. Capital expenditures in 1987 were $53.85 million.

Modernization of No. 4 paper machine at Niagara of Wisconsin Paper Corp. accounted for $20 million in 1986. Capacity is now 220,000 tpy.

Miami Paper Corp. is diversifying into specialty papers for commercial printing, the sector which accounted for 27% of its 1986 output. It planned to introduce two new grades in 1987, following the addition of one in 1986.

Flambeau's sulfite pulp operation was modernized in 1987 to increase production by 28%, improve quality, and lower cost; ultimately, this spells better paper in the mill's range of printings, short custom runs, and specialties. The major investment since Flambeau was acquired, however, has been to meet environmental regulations.

The Port Huron mills concentrated on financial printing paper and lightweight grades for bible and reference. The Port Huron, Mich., mill was sold to E.B. Eddy Forest Products Ltd. in fall 1987. In early 1988, Pentair announced it was selling the Detroit, Mich., mill to Kapaco Group.

Production facilities:

DULUTH, MINN.
(Lake Superior Paper Industries)
Supercalendered paper—575 tpd

WEST CARROLLTON, OHIO
(Miami Paper Corp.)
Pulp—100 tpd deinked
Printing/publication paper—275 tpd

NIAGARA, WIS.
(Niagara of Wisconsin Paper Corp.)
Pulp—210 tpd groundwood
Printing/publication paper—600 tpd

PARK FALLS, WIS.
(Flambeau Paper Corp.)
Pulp—140 tpd sulfite
Fine papers—350 tpd

Total production capacity:

PULP	
Deinked	100 tpd
Groundwood	210 tpd
Sulfite	140 tpd
Total	450 tpd

PAPER	
Printing/publication	875 tpd
Fine	350 tpd
Supercalendered	575 tpd
Total	1,800 tpd

Pope & Talbot Inc.

1500 S.W. First Ave.
Portland, Ore. 97201
Peter T. Pope, chairman/chief executive officer

Net sales (revenues):	
1987	$426,908,000
1986	310,228,000
1985	325,203,000
1984	320,042,000
Net income:	
1987	28,129,000
1986	15,815,000
1985	6,648,000
1984	–558,000

Pope & Talbot has two industries: wood products and pulp and paper products—the manufacture and sale of bleached kraft pulp and tissue products and diapers. Pulp and paper provide 47% of sales. In early 1987, the company acquired the Ransom, Pa., mill from Potlatch Corp. and integrated it into the Absorbent Products Div. This purchase gave P&T an entrance into the East Coast markets and fits the company's long-term goal to produce private label and generic tissue and disposable diapers at low-cost manufacturing facilities. A diaper plant P&T is building in the Atlanta, Ga., area will start up in 1988. P&T recently acquired four Riegle diaper plants from Georgia-Pacific Corp.

Pulp and paper products contributed $219.9 million in sales and $39.5 million in operating profit to the company total in 1987.

Output of bleached softwood pulp in 1987 was 160,000 tons, and output of consumer tissue products was 133,000 tons (capacity 137,000 tons). In addition, 195,000 tons of reclaimed paper pulp were produced—100% of capacity.

Pulp capacity at Halsey, Ore., is 175,000 tpy. By a 1985 price formula agreement, P&T supplies about 70,000 tpy of pulp to James River Corp.'s adjacent tissue and converting facility. The balance is sold as a partially dried market pulp mainly to newsprint manufacturers in the Pacific Northwest. P&T is studying a 284,000-tpy expansion of the Halsey pulp mill.

In 1987, $36.6 million in capital expenditures went to pulp and paper products.

Land and timber assets, 78,000 acres, were transferred to Pope Resources, a limited partnership.

Production facilities:

HALSEY, ORE.
(Pope & Talbot Pulp Inc.)
Pulp—420 tpd bleached softwood and hardwood kraft (for market)

RANSOM, PA.
(Absorbent Products Div.)
Pulp—180 tpd deinked
Tissue—135 tpd

EAU CLAIRE, WIS.
(Absorbent Products Div.)
Pulp—300 tpd deinked
Paper—200 tpd tissue, towel

LADYSMITH, WIS.
(Absorbent Products Div.)
Paper—80 tpd tissue, wadding

Total production capacity:

PULP	
Bleached kraft	420 tpd
Deinked	480 tpd
Total	900 tpd

PAPER	
Tissue	415 tpd

Potlatch Corp.

One Maritime Plaza
San Francisco, Calif. 94111
Richard B. Madden, chairman/chief executive officer

Net sales:	
1987	$992,077,000
1986	976,373,000
1985	950,323,000
1984	993,910,000
Net earnings	
1987	87,623,000
1986	69,943,000
1985	37,669,000
1984	49,631,000

Potlatch is a diversified forest products company which makes bleached paperboard and packaging, coated free-sheet paper, private label tissue, and lumber and panel products. Of total sales, 75% is derived from pulp, paper/paperboard, and converted products.

The company extensively restructured its Idaho wood products operations in 1985 by winning concessions from unions and modernizing facilities. Cost reduction steps have also been taken at its pulp and paper mills. The company had to take on significant debt in a 1985 share repurchase program to ward off a takeover attempt by the Belzberg family. However, management has been restrained in its capital spending program in recent years. Potlatch seeks to strengthen its position in solid bleached paperboard and in coated and uncoated paper grades using its strong resource base. The Ransom, Pa., mill was sold to Pope & Talbot Inc. in January 1987.

Paper sales in 1987 reached $291.3 million; pulp and paperboard sales were $294.1 million; and tissue sales were $88.5 million.

Potlatch has capacity for 826,300 tpy of bleached kraft pulp, 289,500 tpy of printing paper, and 85,400 tpy of tissue and toweling. Pulp output in 1987 was 816,824 tons. Paper/paperboard production was 899,328 tons. Of this, 266,268 tons was printing paper; 85,799 tons, tissue and toweling; and 546,202 tons, bleached paperboard.

Capital expenditures totaled $155.2 million in 1987, up from $95.6 million in 1986, and they were budgeted for $198 million in 1987. Potlatch will spend $28 million for an off-machine coater (startup 1989) for the Cloquet, Minn., mill, installing it on the new $75-million free-sheet machine (startup first-quarter 1988) that replaces three older units. A $17.5-million project will install a new caustic plant at the Lewiston, Idaho, bleached board plant. Capacity will be increased by 100 tpd. Completion date is 1989.

Potlatch owns 1,410,000 acres of timberland in Arkansas, Idaho, and Minnesota.

Production facilities:

McGEHEE, ARK.
(Cypress Bend Pulp Mill)
Pulp—545 tpd bleached kraft (small amount for market)
Bleached paperboard—600 tpd

LEWISTON, IDAHO
(Paperboard Div.)
Pulp—1,120 tpd bleached kraft (some for market)
Bleached paperboard—920 tpd

LEWISTON, IDAHO
(Consumer Products Div.)
Tissue—240 tpd

BRAINERD, MINN.
(Northwest Paper Div.)
Printing paper—360 tpd

CLOQUET, MINN.
(Northwest Paper Div.)
Pulp—520 tpd bleached kraft
Printing paper—405 tpd

Total production capacity:

PULP	2,185 tpd
PAPER & BOARD	
Printing	765 tpd
Tissue	240 tpd
Paperboard	1,520 tpd
Total	2,525 tpd

Procter & Gamble Co.

2 Procter & Gamble Plaza
Cincinnati, Ohio 45202
Richard R. Nicolosi, vice president, Paper Products Div.
T.M. Courtney, vice president, Cellulose & Specialties Div.

(Wholly owned subsidiaries are Procter & Gamble Paper Products Co., Buckeye Cellulose Corp., and Procter & Gamble Cellulose Ltd.)

Financial data for P&G's papermaking operations not available.

P&G first entered the pulp and paper business through construction of its Foley, Fla., pulp mill in 1951. In 1957, P&G acquired a company with two tissue mills in the Midwest, which was renamed Charmin Paper and expanded into a national producer with the addition of mills at Mehoopany, Pa. (built 1966); Oxnard, Calif. (acquired from International Paper in 1974); and Albany, Ga. (built in 1971). The company backed its expansion into tissue with an aggressive marketing program and the development of superior products. Charmin was the first producer to commercialize through-air pre-drying of tissue paper, a technology which offers improved softness and absorbency. P&G's major brands (Charmin and White Cloud toilet tissue and Puffs facial tissue) gained market share at the expense of other producers.

The company entered the baby diaper business in 1961 when it first began to test market its Pampers brand in Peoria, Ill. This brand, along with Luvs, a premium diaper introduced in 1980, came to dominate the U.S. diaper market. P&G, however, saw its share decline from more than 70% in the 1970s to about 50% by the end of 1984, mainly due to competition from private label producers on the low end and Kimberly-Clark Corp.'s Huggies brand on the high end. Competition has been fierce in the $3-billion baby diaper market due to rapidly changing technology, such as the use of synthetic superabsorbents to replace some fluff pulp. In 1985, the company announced it was spending $500 million on retooling its converting lines to make the new diapers. Helped by its new, thin, superabsorbent diapers (Ultra Pampers, Luvs Deluxe, and Ultra Plus), P&G's market share rebounded to about 59% in early 1986 before settling back to about 53% in the first half of 1987.

The company's tissue mills and diaper converting plants are supplied with pulp by its Foley, Fla.; Grand Prairie, Alta.; and Oglethorpe, Fla., pulp mills (the last built in 1981). In mid-1986, P&G announced it would phase out ammonia-based sulfite pulp production at the Fox River mill in Green Bay, Wis., with pulp for the tissue mills to come from the Alberta facility.

Production facilities:

(Procter & Gamble does not release capacity figures; the following are estimates.)

OXNARD, CALIF.
(Procter & Gamble Paper)
Tissue grades

FOLEY (Perry), FLA.
(Buckeye Cellulose Corp.)
Pulp—1,335 tpd dissolving, fluff, and paper-grade kraft

ALBANY, GA.
(Procter & Gamble Paper)
Tissue grades—500 tpd

OGLETHORPE, GA.
(Buckeye Cellulose Corp.)
Pulp—860 tpd bleached kraft (mainly fluff pulp)

CHEBOYGAN, MICH.
(Procter & Gamble Paper)
Tissue grades—60 tpd

MEHOOPANY, PA.
(Procter & Gamble Paper)
Pulp—sulfite
Tissue grades—750 tpd

MEMPHIS, TENN.
(Buckeye Cellulose Corp.)
Pulp—265 tpd cotton linters

GREEN BAY, WIS.
(Procter & Gamble Paper: East River & Fox River mills)
Pulp—650 tpd sulfite
Tissue grades—1,000 tpd

GRANDE PRAIRIE, ALTA.
(Procter & Gamble Cellulose Ltd.)
Pulp—840 metric tpd (925 short) bleached kraft (partly for market)

Total production capacity:

PULP (short tons)	
Cotton linters	265 tpd
Kraft	3,120 tpd
Sulfite	650 tpd
Total	4,035 tpd
PAPER	
Tissue	2,570 tpd

Quebec & Ontario Paper Co. Ltd.

80 King St., 8th floor
St. Catharines, Ont. L2R 7G2
John E. Houghton, president/chief executive officer

(Quebec & Ontario Paper Co. Ltd.—which changed its name from Ontario Paper Co. Ltd. in September 1987—and its QNS Paper Co. Ltd. subsidiary are owned by Chicago-based Tribune Co.)

Net sales (C$):	
1987	$513,712,000
1986	528,176,000
1985	503,876,000
1984	467,611,000
Net income (C$):	
1987	67,345,000
1986	31,820,000
1985	33,443,000
1984	7,904,000

Q&O manufactures newsprint at Thorold, Ont., and Baie Comeau, Que. The company also has chemicals, power, and sawmill interests, and it operates a newspaper recycling program.

Eighty-five percent of sales are derived from pulp, paper, paperboard, and converting operations. The drop in 1987 sales reflected sale of chemical operations. Output in 1987 reached 702,600 short tons.

Included in 1987 capital expenditures was $36 million to build a 170,000-metric-tpy recycled pulp mill at Thorold, Ont., which started up in late 1987. At that time a 70,000-metric-tpy sulfite pulp mill was shut down, as well as the vanillin plant.

In spring 1988, the company announced it would build a 600-metric-tpd thermomechanical pulp mill at Baie Comeau, Que., replacing the sulfite pulping operation. Completion is set for late 1989. Upgrades to newsprint machines in 1987-88 will raise capacity to 17,500 tpy.

Q&O owns 263,000 acres of timberlands in Canada and controls another 6,185,000 acres.

Production facilities:

THOROLD, ONT.
Pulp—500 metric tpd thermomechanical; 220 tpd deinked news, 190 tpd unbleached sulfite
Newsprint—850 metric tpd

BAIE COMEAU, QUE.
(QNS Paper Co. Ltd.)
Pulp—790 metric tpd groundwood; 210 tpd Opco pulp (sodium-sulfite treated thermomechanical); 345 tpd sulfite
Newsprint—1,200 metric tpd

Total production capacity:

PULP	
Groundwood	790 metric tpd
TMP	500 metric tpd
Opco pulp	210 metric tpd
Unbleached sulfite	535 metric tpd
Deinked news	220 metric tpd
Total	2,255 metric tpd
PAPER	
Newsprint	2,050 metric tpd

Reed Paper Inc.

207 Queens's Quay W.
Toronto, Ont. M5J 1A7
J. Peter Williams, president/chief executive officer

(Beneficially owned 100% by Reed International plc, a U.K. resident holding company. In May 1988, the parent company announced it would sell its paper-related businesses in Europe and North America. In June, Reed International reached an agreement to sell the North American facilities to the Canadian subsidiary of Daishowa Paper Mfg. Co. of Japan.)

North American Paper

Turnover (C$):	
1987	$366,000,000
1986	305,000,000
1985	305,000,000
1984	324,000,000
Trading profit (C$):	
1987	50,000,000
1986	27,100,000
1985	13,100,000
1984	11,600,000

(fiscal year ends March 31)

Reed's North American Paper group is mainly a producer of newsprint but also manufactures some market pulp, boxboard, lumber, chemicals, and packaging. Faced with serious financial problems in the late 1970s, Reed divested its Dryden, Ont., paper mill and sold its interest in two British Columbia pulp mills.

The company is now concentrating on improving the competitive position of its large Quebec City, Que., mill. In 1984, another C$40 million was spent in the program begun in 1979 to modernize all four paper machines to improve newsprint quality and to increase output. The program was completed in 1986, when the last machine started up, and it resulted in a 25% capacity increase. Reed plans to spend C$146 million to install a 600-metric-tpd thermomechanical pulping system and to improve a newsprint machine, plus other projects. Completion is set for mid-1989.

Production facilities:

QUEBEC CITY, QUE.
Pulp—800 metric tpd groundwood; 375 tpd sulfite (65 tpd for market)
Newsprint—1,160 metric tpd
Paperboard—95 metric tpd

Total production capacity:

PULP	
Groundwood	800 metric tpd
Sulfite	375 metric tpd
Total	1,175 metric tpd
PAPER & BOARD	1,255 metric tpd

Repap Enterprises Corp. Inc.

1155 Dorchester Blvd. W.
Montreal, Que. H3B 3S7
George S. Petty, chairman/chief executive officer

[Repap Enterprises became a public company in December 1986. It is comprised of Midtec Paper Corp. at Kimberly, Wis.; Miramichi Pulp & Paper Inc., which includes two mills at Newcastle, N.B., and one at Nelson-Miramichi, N.B. (formerly Acadia Forest Products Ltd.); and Skeena Cellulose Inc., Prince Rupert, B.C. It has a 13.7% interest in Tembec Inc. Repap sold equipment at the closed Nitec Paper Corp. mill at Niagara Falls, N.Y., to Cascades Inc.]

Net sales (C$):	
1987	$927,000,000
1986	635,500,000
1985	429,300,000
1984	364,300,000
Net earnings (C$):	
1987	62,500,000
1986	13,000,000
1985	2,800,000
1984	6,600,000

Repap has developed expertise in buying older mills at bargain prices and making them profitable. The strategy has made the company a significant North American producer of market pulp and coated paper.

The company's major move in 1986 was the purchase of the Skeena Pulp Div of Westar Timber Ltd. for a bargain price of about $109 million (including working capital). Repap continued operation of the A mill and restarted the B mill, which had been down since March 1985, shortly after acquiring the mill.

This followed the startup of a new coated groundwood paper machine at Newcastle, N.B. Pulp for the machine is supplied by a nearby kraft pulp mill (acquired from Boise Cascade in 1985) and by the Acadia groundwood pulp mill.

In 1987, Repap had capacity for 700,000 metric tpy of woodpulp, of which 615,000 tons was softwood kraft and 165,000 tons was groundwood pulp. Its capacity for coated paper was 509,000 metric tons. Capacity by operation was: Midtec, 309,000 metric tons of coated paper, 40,000 tons of groundwood pulp; Miramichi, 200,000 metric tons of coated paper, 190,000 tons of softwood kraft, and 125,000 tons of groundwood pulp; and Skeena, 425,000 metric tons of softwood kraft pulp.

Repap reported 1987 production of 394,000 metric tons of coated paper (295,000 tons in 1986). It also reported production of 712,000 tons of woodpulp (501,000 tons in 1986), of which 582,000 tons (365,000 tons in 1986) were softwood kraft and 130,000 tons (136,000 tons in 1986) were groundwood.

Repap spent C$260.5 million in 1986 on capital projects and acquisitions. Capital expenditures of $40,194,000 in 1984 on its coated paper mills, and $215,419,000 in 1985 on both pulp and paper mills boosted capacity in both Canadian and U.S. operations.

Included in 1987 capital expenditures and acquisitions of C$281.2 million were $250 million for a 580-tpd coated free-sheet machine at the Midtec mill. The new machine will add about 100,000 tons to capacity and replace four older machines. And at this time, Repap will have replaced or modernized all of the original Midtec machines.

A project to build a second coated paper machine at the Miramichi mill at Newcastle, N.B., was announced in May 1988. The new machine will have capacity for 20,000 to 260,000 metric tpy, depending on grade. This will put Repap in the top rank among North American coated paper producers.

Repap is involved in the development of a nonsulfur pulping process. In 1988, the company announced plans to spend C$45 million to install a pilot pulp plant at Miramichi using its proprietary ethanol-based Alcell process. The plant will be built from currently available equipment and will be online by early 1989.

Repap has 3.7 million acres of timberland in Canada under lease, 1.8 million acres supplying Miramichi operations, and 1.9 million acres supplying the Skeena operations.

Production facilities:

PRINCE RUPERT, B.C.
(Skeena Cellulose Inc.)
Pulp—1,200 metric tpd bleached kraft (for market)

KIMBERLY, WIS.
(Midtec Paper Corp.)
Pulp—120 metric (132 short) tpd groundwood
Coated paper—850 (937 short) tpd

Miramichi Pulp & Paper Inc.

NELSON-MIRAMICHI, N.B.
(Acadia Groundwood Pulp Mill)
Pulp—400 metric tpd groundwood

NEWCASTLE, N.B.
(Miramichi Coated Paper Mill)
Coated paper—600 metric tpd

NEWCASTLE, N.B.
(Newcastle Kraft Pulp Mill)
Pulp—545 metric tpd kraft

Total production capacity:

PULP (metric tons)	
Groundwood	520 metric tpd
Kraft	1,745 metric tpd
Total	2,265 metric tpd
PAPER	
Coated	1,450 metric tpd

Rock-Tenn Co.

Box 4098
Norcross, Ga. 30091
A.W. Brown, chairman/chief executive officer

Financial data not available.

A privately held company, Rock-Tenn had sales in 1987 of $388 million, up 6% from the year earlier.

Between 1979 and 1983, the company acquired four recycled board mills and 26 converting plants with an annual production of 300,000 tons. R-T also has converting and distribution facilities for container and plastic products.

In late 1987, Rock-Tenn announced that it would buy Mead Corp.'s three recycled board mills and a converting plant, thereby nearly doubling its recycled board capacity and moving into fifth place in this sector in the U.S. The recycled business is divided between folding boxboard and solid fiber industrial products.

Production facilities:

EATON, IND.
Paperboard—140 tpd chipboard

OTSEGO, MICH.
(Former Mead Corp. mill)
Recycled board—130 tpd

CINCINNATI, OHIO
(Former Mead Corp. mill)
Recycled board—130 tpd

DELAWARE WATER GAP, PA.
Paperboard—130 tpd boxboard, clay-coated board

CHATTANOOGA, TENN.
Recycled paperboard—350 tpd

DALLAS, TEXAS
Recycled paperboard—415 tpd

LYNCHBURG, VA.
(Former Mead Corp. mill)
Recycled board—385 tpd

Total production capacity:

PAPERBOARD	1,780 tpd

St. Joe Paper Co.

803 Edward Ball Bldg.
Jacksonville, Fla. 32202
J.C. Belin, chairman/chief executive officer

Financial data not available.

St. Joe Paper Co. is part of St. Joe Forest Products Co., which in turn is part of St. Joe Industries Inc., one of the two operating divisions created when the company reorganized in 1986. (The other is St. Joe Properties Inc.) St. Joe Forest Products also includes St. Joe Container, which has 20 box plants, and St. Joseph Land & Development Co., which controls the firm's 1.1 million acres of Florida timberland.

Production facilities:

PORT ST. JOE, FLA.
Pulp—1,700 tpd
Kraft linerboard—1,300 tpd

Total production capacity:

PULP	1,700 tpd
PAPERBOARD	1,300 tpd

Scott Paper Co.

Scott Plaza
Philadelphia, Pa. 19113
Philip E. Lippincott, chairman/chief executive officer

(Scott recently sold its 50% share in Brunswick Pulp & Paper Co. with Mead Corp. Scott Maritimes Ltd. is a wholly owned subsidiary. In 1985, Scott acquired the 24.9% stake owned by Brascan Ltd. In 1986, it bought Bowater Industries plc's 50% ownership of Bowater-Scott Corp. Ltd. in a move to strengthen its European operations, and it renamed the unit Scott Ltd.)

Net sales:	
1987	$4,122,000,000
1986	3,437,000,000
1985	3,049,500,000
1984	2,847,300,000
Net income	
1987	233,800,000
1986	186,500,000
1985	201,100,000
1984	187,021,000

Scott has honed its operations to include only Personal Care and Cleaning (includes tissue operations, in which it is a worldwide leader), printing and publishing papers (a U.S. leader), and pulp, forest products, and minerals. The S.D. Warren subsidiary concentrates on its traditional line of heavy coated grades, plus lighter-weight grades and specialties such as release papers and base materials for pressure-sensitive labels.

In late 1987, Scott announced plans to spend $250-million in Europe on sanitary paper expansions, with three machines to be installed in three years.

Sales by the printing/publishing papers sector were $1,080.3 million in 1987 (26% of total); sales by the pulp, forest products, and minerals sector were $216.1 million (5% of total).

Scott Paper Ltd. reported net sales of C$288,396,000 in 1987, $261,854,000 in 1986, and $246,820,000 in 1985. Net income was C$14,514,000, $12,929,000, and $11,183,000, respectively.

In 1986, a $40-million modernization program to increase capacity, reduce energy costs and improve environment was completed by Scott Maritimes Pulp at Ambercrombie Point, N.S. In an efficiency move, more pulp from this mill is being allocated to paper mills. (Scott is one of the few tissue manufacturers that make more pulp than for own use.)

A second coated, $220-million paper machine was started up in September 1986 at the Somerset mill in Skowhegan, Maine. It has capacity for 215,000 tpy, about doubling the mill's lightweight coated capacity.

Scott Natural Resources manages 3,200,000 acres of woodlands in U.S. and Canada.

Production facilities:

(Scott does not release capacity data; information below is estimated and incomplete.)

MOBILE, ALA.
(Southern Operations)
Pulp—1,450 tpd kraft; also deinked
Tissue—750 tpd
Other paper grades (mainly printing/writing)—800 tpd

SKOWHEGAN (Hinckley), MAINE
(S.D. Warren Div., Somerset Mill)
Pulp—900 tpd bleached kraft (300 for market)
Paper—600 tpd coated free-sheet

WESTBROOK, MAINE
(S.D. Warren Div.)
Pulp—295 tpd bleached kraft
Coated printing and specialty papers—550 tpd

WINSLOW, MAINE
(S.D. Warren Div.)
Pulp—485 tpd sulfite (pulp mill idle)
Paper—580 tpd tissue, toweling, waxing, coating-base, specialty

MUSKEGON, MICH.
(S.D. Warren Div.)
Pulp—250 tpd bleached kraft
Coated printing and specialty papers—400 tpd

FORT EDWARD, N.Y.
Tissue—180 tpd

CHESTER, PA.
Tissue—1,060 tpd

EVERETT, WASH.
(Northwest Operations)
Pulp—525 tpd sulfite; 30 tpd groundwood
Tissue, towel—600 tpd

MARINETTE, WIS.
Tissue—350 tpd

OCONTO FALLS, WIS.
(Mill idle)
Toweling

NEW WESTMINSTER, B.C.
(Scott Paper Ltd.)
Pulp—85 metric tpd (94 short) groundwood
Tissue—300 metric tpd (330 short)

ABERCROMBIE POINT, N.S.
(Scott Maritimes Ltd.)
Pulp—600 metric tpd (662 short) bleached kraft (some for market)

CRABTREE, QUE.
(Eastern Mfg. Div.)
Pulp—90 metric tpd (92 short) deinked
Tissue—100 metric tpd (110 short)

LENNOXVILLE, QUE.
(Eastern Mfg. Div.)
Pulp—45 metric tpd (50 short) deinked
Tissue—45 metric tpd (50 short)

Total production capacity:

PULP (short tons)	
Kraft	4,207 tpd
Sulfite	1,010 tpd
Groundwood	124 tpd
Deinked	142 tpd
Total	5,483 tpd
PAPER & BOARD (short tons)	
Tissue grades	4,010 tpd
Printing/writing	800 tpd
Coated papers	1,550 tpd
Bleached linerboard	200 tpd
Total	6,560 tpd

Simpson Paper Co.

(Sub. of Simpson Investment Co.)
One Post St.
San Francisco, Calif. 94104
John Fannon, president

Financial data not available.

Simpson has continued to grow through acquisitions. In late 1985, it purchased the unbleached pulp, paper, and linerboard mill in Tacoma, Wash., from Champion International Corp., thus marking a diversification from its white paper and market pulp operations. The mill integrated into Simpson's timber operations, however, and brought 240,000 acres of timberland. The West Coast site is also well situated for exports to the Far East, an attractive market. In early 1987, the company bought the coated and uncoated printing/writing paper mill at Pasadena, Texas, from Champion; Champion continues to supply wood and to market some of the products. In late 1987, Simpson bought the Plainwell, Mich., mill from Chesapeake Corp. to boost its output of premium coated printing papers at a site to serve eastern markets.

Production facilities:

ANDERSON, CALIF.
Pulp—230 tpd kraft
Printing/writing paper—420 tpd

FAIRHAVEN, CALIF.
(Crown Simpson Co.)
Pulp—640 tpd bleached kraft (470 for market)

POMONA, CALIF.
Pulp—65 tpd deinked
Printing/writing paper—320 tpd

RIPON, CALIF.
Printing/writing paper—20 tpd
Fine papers—70 tpd

PLAINWELL, MICH.
(Former Plainwell Paper Co., Chesapeake Corp., mill)
Coated and uncoated paper—245 tpd

VICKSBURG, MICH.
Fine papers—80 tpd
Special industrial paper—20 tpd

MIDDLETOWN, OHIO
(Harding-Jones Paper Co.)
Rag-content paper—20 tpd

MIQUON, PA.
Fine papers—130 tpd

PASADENA, TEXAS
(Simpson Pasadena Paper Co.)
Pulp—600 tpd kraft
Printing/writing papers—725 tpd

TACOMA, WASH.
Pulp—1,160 tpd unbleached kraft (270 for market)
Paper/board—880 tpd bag, multiwall, converting, linerboard

Total production capacity:

PULP	
Kraft	2,630 tpd
Deinked	65 tpd
Total	2,695 tpd

PAPER	
Printing/writing	1,485 tpd
Fine paper	525 tpd
Rag-content paper	20 tpd
Special industrial	20 tpd
Paper/board	880 tpd
Total	2,930 tpd

Jefferson Smurfit Corp.

(Sub. of Jefferson Smurfit Group Ltd., Ireland)
8182 Maryland Ave.
Jefferson Smurfit Centre
St. Louis, Mo. 63105
Michael W.S. Smurfit, chairman/chief executive officer

[Jefferson Smurfit Group Ltd. holds 78%. JSC owns 80% of Smurfit Newsprint Corp. (Times Mirror Co., 20%); 50% of Container Corp. of America (Morgan Stanley Leveraged Equity Fund, 50%); and 50% of the Monroe, Mich., mill. (Monroe Paper Co., 50%).]

Jefferson Smurfit Corp.

Net sales:	
1987	$1,099,465,000
1986	944,356,000
1985	630,425,000
1984	678,112,000
Net income:	
1987	91,996,000
1986	28,003,000
1985	16,826,000
1984	24,504,000

Container Corp. of America

Net sales:	
1985	$1,666,000,000
1984	1,798,000,000
Operating earnings:	
1985	39,000,000
1984	30,000,000

Jefferson Smurfit Corp., following three acquisitions in 1986 for more than $1.4 billion, is a major recycler of wastepaper (about two million tons annually), and it is a producer of recycled paperboard, spiral cores and tubes, and newsprint.

The major acquisition was 50% of Container Corp. of America and its nine mills in the U.S. (There are also foreign holdings.) Mobil Corp. solds its subsidiary to JSC-MS Holdings Inc., formed by Smurfit and Morgan Stanley Leveraged Equity Fund to make this purchase. Smurfit has an option to buy the 50% held by Morgan Stanley in the three years following Sept. 30, 1990.

In 1987, JSC produced 835,000 tons of paperboard and 603,000 tons of newsprint. The folding carton and boxboard mills produced over 600,000 tons of boxboard. The industrial packaging mills produced 200,000 tons of recycled cylinderboard.

Combined sales of JSC/CCA in 1987 were $2,993 million. Total paperboard and newsprint output was 3,855,000 tons.

Capital expenditures in 1987 were $35 million, up from $30.8 million in 1986. In early summer 1988, JSC announced it may restart an idle machine to produce about 600 tpd of recycled medium and linerboard at the Fernandina Beach, Fla., mill of CCA.

JSC owns 39,000 acres of timberland, and CCA owns 1,195,000 acres.

CCA produced 1,629,000 tons of paperboard in the U.S. in 1985, 52% of it recycled. Paperboard and miscellaneous sales in 1985 accounted for 21% of total CCA sales. Shipping containers accounted for 49% of CCA total sales; plastics and folding cartons made up the balance.

CCA's timberland holdings were 1,057,000 acres at the beginning of 1985.

With the acquisition of 80% of Publishers Paper Co. (renamed Smurfit Newsprint Corp.; JSC has a 10-year option to purchase the remaining 20% from Times Mirror Co.) and its two Oregon mills, Smurfit expanded into newsprint, which it considers a stable grade giving balance to its other operations. The acquisition of Publishers also fulfilled another JSC tenet: fiber should be supplied from internal sources—Publishers supplied its own virgin and reclaimed fiber needs. A 275-metric-tpd newsprint addition was under study in 1987 for the Oregon City, Ore., mill, but the increase in newsprint could be offset by the conversion of existing machines to groundwood papers.

Production facilities:

JACKSONVILLE, FLA.
Pulp—725 tpd unbleached kraft
Kraft linerboard—850 tpd

CEDARTOWN, GA.
Tube stock—50 tpd

ALTON, ILL.
Recycled corrugating medium—600 tpd

LAFAYETTE, IND.
Tube stock, chipboard—100 tpd

MONROE, MICH.
(Smurfit Paperboard (Former Union Camp Corp. mill)
Tube stock, chipboard—125 tpd

MONROE, MICH.
(Jointly owned with Monroe Paper Co.)
Recycled paperboard—250 tpd (JSC's share: 125 tpd)

LOCKLAND, OHIO
Recycled boxboard—272 tpd

MIDDLETOWN, OHIO
(Boxboard Mill Div.)
Recycled boxboard—300 tpd

MIDDLETOWN, OHIO
(Mill idle)
Molded pulp products

NEWBERG, ORE.
(Smurfit Newsprint Co.)
Pulp—350 tpd refiner mechanical; 500 tpd deinked
Newsprint—1,000 tpd

OREGON CITY, ORE.
(Smurfit Newsprint Co.)
Pulp—370 tpd thermomechanical; 300 tpd deinked
Newsprint—600 tpd

Container Corp. of America:

BREWTON, ALA.
  Pulp—1,200 tpd kraft
  Unbleached kraft board—675 tpd
  Solid bleached board—475 tpd

SANTA CLARA, CALIF.
  Recycled board—270 tpd

VERNON, CALIF.
  Recycled paperboard—460 tpd

FERNANDINA BEACH, FLA.
  Pulp—2,000 tpd kraft
  Unbleached kraft board—2,100 tpd

CARTHAGE, IND.
  Recycled board—125 tpd

WABASH, IND.
  Recycled board—320 tpd

CIRCLEVILLE, OHIO
  Pulp—200 tpd semichemical
  Semichemical corrugating medium—325 tpd

PHILADELPHIA, PA.
  Recycled board—475 tpd

TACOMA, WASH.
  Recycled board—65 tpd

Total production capacity:

PULP	
Kraft	3,925 tpd
Refiner mechanical	350 tpd
Semichemical	200 tpd
TMP	370 tpd
Deinked	800 tpd
Total	5,645 tpd
PAPER & BOARD	
Newsprint	1,600 tpd
Linerboard	850 tpd
Kraft board	3,230 tpd
Corrugating medium	925 tpd
Recycled board	2,412 tpd
Tube, chipboard	275 tpd
Total	9,312 tpd

Sonoco Products Co.

North Second St.
Hartsville, S.C. 29550-0160
Charles W. Coker, president

Net sales:	
1987	$1,312,052,000
1986	963,796,000
1985	869,598,000
1984	740,869,000
Net income:	
1987	61,482,000
1986	54,676,000
1985	49,409,000
1984	42,535,000

Sonoco is a major manufacturer of packaging products and the world's leading producer of tubes, cores, cones, and uncoated cylinder paperboard. It produces composite cans, fiber drums and partitions, corrugating medium, and other packaging items. It is one of the world's leading consumers of wastepaper. Sonoco stresses vertical integration but grows through acquisitions. In 1987, it purchased Boise Cascade Corp.'s Consumer Packaging Div. (composite cans). Early in 1988, it signed an agreement with Federal Paper Board Co. to purchase the Richmond, Va., recycled boxboard mill, increasing its recycled paperboard capacity to about 700,000 tpy and making it the largest U.S. producer of this grade.

The U.S. paper sector accounted for $223.7 million in sales in 1987, 9.9% of the company total. Canadian results are included with the international segment, which had sales of $193 million in 1987.

Sonoco produced about 565,000 tons of uncoated cylinderboard in the U.S. in 1987, which was nearly at capacity. The Hartsville, S.C., mill produced about 150,000 tons of corrugating medium.

Capital spending in 1987 was about $105 million, not including acquisitions, and the company foresees similar spending in the near future. Of this amount, $17 million was spent on the U.S. paper sector (up from $9.5 million in 1986), and about $9 million was spent on international operations, including Canada.

Sonoco owns 19,000 acres of timberland and controls an additional 24,000 acres.

Production facilities:

CITY OF INDUSTRY, CALIF.
  Paperboard—69 tpd

ATLANTA, GA.
  Paperboard—102 tpd

ROCKTON, ILL.
  Paperboard—66 tpd

HOLYOKE, MASS.
  Paperboard—234 tpd

AMSTERDAM, N.Y.
  Paperboard—57 tpd

LANCASTER, OHIO
  Paperboard—86 tpd

MUNROE FALLS, OHIO
  Paperboard—71 tpd

DOWNINGTOWN, PA.
  Paperboard—160 tpd

HARTSVILLE, S.C.
  Pulp—200 tpd semichemical
  Corrugating medium—444 tpd
  Paperboard—535 tpd

NEWPORT, TENN.
  Paperboard—262 tpd

RICHMOND, VA.
(Former Federal Paper Board Co. mill)
  Recycled board—239 tpd

SUMNER, WASH.
  Paperboard—72 tpd

BRANTFORD, ONT.
(Sonoco Ltd.)
  Paperboard—130 metric tpd (143 short)

TERREBONNE, QUE.
(Sonoco Ltd.)
  Paperboard—55 metric tpd (60 short)

Total production capacity:

PULP (short tons)	200 tpd
PAPERBOARD (short tons)	
Paperboard	2,169 tpd
Corrugating medium	444 tpd
Total	2,613 tpd

Southeast Paper Mfg. Co.

Box 1169
Dublin, Ga.
Robert F. Wilson, president

(Southeast is owned equally by Knight-Ridder Inc., Cox Enterprises Inc., and Media General Corp. Media General also owns Garden State Paper Co. Inc.)

Financial data not available.

In September 1987, Southeast confirmed a $300-million expansion plan which will add about 590 tpd of newsprint capacity (437,000 tpy total), with startup of a new machine in 1989. New deinking facilities will be built and wastepaper reclamation capacity expanded to provide furnish for the new machine. Southeast uses Garden State Paper Co. technology in producing newsprint from recycled newspapers.

Production facilities:

DUBLIN, GA.
  Pulp—450 tpd deinked; 50 tpd thermomechanical
  Newsprint—560 tpd

Total production capacity:

PULP	
Deinked	450 tpd
TMP	50 tpd
Total	500 tpd

PAPER	560 tpd

Stone Container Corp.

360 N Michigan Ave
Chicago, Ill 60601
Roger W Stone, chairman/chief executive officer

Stone Container Corp.

Net sales:	
1987	$3,232,919,000
1986	2,032,325,000
1985	1,229,148,000
1984	1,244,395,000
Net income:	
1987	161,324,000
1986	35,415,000
1985	3,778,000
1984	33,657,000

Southwest Forest Industries Inc.

Net sales:	
1986	631,487,000
1985	582,149,000
1984	674,238,000
Net earnings:	
1986	-1,700,000
1985	-9,823,000
1984	4,092,000

Stone Container has grown from a second-tier player to the largest producer of containerboard and kraft paper in the U.S. through a series of acquisitions made during the past five years. It has taken advantage of the earlier industry downturn to acquire other companies at favorable prices using leveraged financing. The company held back on capital spending and used the strong cash flow generated by the 1986-87 industry recovery to reduce debt. In the future, however, the company may face significant capital outlays to modernize some of its higher-cost mills.

In 1987, Stone acquired Southwest Forest Industries Inc., with two mills producing linerboard, market pulp, and newsprint—Stone's first entry into the latter two grades. This followed the acquisition by 49%-owned Seminole Kraft Corp. of the idle Jacksonville Kraft Paper Co. mill which was reactivated in the spring of 1987. These acquisitions followed the purchase of three containerboard mills and 52 converting plants from Champion International Corp. in 1985 and the acquisition of three containerboard mills and 20 box and bag plants from Continental Forest Industries in 1984.

Sales of paper and paperboard were $998 million in 1987 (31% of company total). Of this, containerboard contributed 76%; kraft paper, 15%; newsprint, 5%; and market pulp, 4%.

In 1987, capacity for market pulp, paper, and containerboard reached 4.867 million tons, and production was 4.373 million tons. Segment breakdowns (production in parentheses, in thousands): linerboard 2,674,000 and corrugating medium 847,000 (containerboard 3,299.7); kraft paper 773,500 (641); newsprint 284,200 (213); market pulp 247,400 (180); and specialties 40,700 (39).

Capital expenditures in 1987 were $105.7 million, up from $63.3 million in 1986.

In a $24-million project, the Uncasville, Conn., recycled corrugating medium mill will be expanded to 400 tpd capacity by fall 1989.

A new company, Stone Forest Industries Inc., was formed to acquire Stone Container Corp.'s forest products operations, including 334,000 acres of private-fee timberland included in the purchase of Southwest Forest Industries, plus plywood, veneer, and lumber plants. Stone Container holds 49% of the shares in the new firm. In accordance with company policy not to own timberlands, about 33,800 acres of non-core assets were sold early in 1988.

Southwest's Snowflake, Ariz., mill makes linerboard and newsprint; the Panama City, Fla., mill produces linerboard and market pulp. SFI was a leading manufacturer of corrugated containers, multiwall, and grocery bags and sacks. Annual capacities are: market pulp, 240,000 tons; newsprint, 280,000 tons; and linerboard, 440,000 tons. Shipments in 1986 (1985 figures in parentheses) were: newsprint, 260,000 tons (176,000 tons); kraft linerboard, 434,000 tons (395,000 tons); and market pulp, 233,000 tons (207,000 tons).

Sales of pulp, newsprint, linerboard, and shipping containers in 1986 were $419,310,000, a 12% increase over Paper Products Group sales in 1985. The group's operating income also increased, rising from a loss of $9,915,000 in 1985 to earnings of $2,124,000 for 1986. Sales of pulp, paper, and paperboard accounted for 60% of total 1986 sales.

Capital expenditures company-wide were $28.8 million in 1986. SFI had plans to spend $75,000,000 by 1988 on the Panama City, Fla., mill in order to add 200 tpd of capacity by modifying a linerboard machine to use recycled fiber.

Production facilities:

Stone Container Corp.

UNCASVILLE, CONN.
Corrugating medium—230 tpd

JACKSONVILLE, FLA.
(Seminole Kraft Corp.)
Pulp—1,470 tpd bleached kraft (Stone's share: 720 tpd)
Linerboard—1,084 tpd (Stone's share: 531 tpd)
Kraft paper—347 tpd (Stone's share: 170 tpd)

PORT WENTWORTH, GA.
Pulp—800 tpd unbleached kraft
Linerboard—981 tpd

HODGE, LA.
Pulp—1,400 tpd unbleached kraft, 300 tpd semichemical
Kraft papers—1,398 tpd
Corrugating medium—382 tpd

ONTONAGON, MICH.
(Formerly Champion International Corp. mill)
Pulp—550 tpd semichemical
Corrugating medium—681 tpd

MISSOULA, MONT.
(Formerly Champion International Corp. mill)
Pulp—1,900 tpd unbleached kraft
Linerboard—1,962 tpd unbleached

COSHOCTON, OHIO
Pulp—600 tpd semichemical
Corrugating medium—859 tpd

YORK, PA.
(Formerly Champion International Corp. mill)
Corrugating medium—268 tpd
Specialty paper/board—118 tpd

FLORENCE, S.C.
Pulp—1,400 tpd unbleached kraft
Linerboard—1,394 tpd
Kraft paper—397 tpd

HOPEWELL, VA.
Pulp—1,000 tpd unbleached kraft
Linerboard—1,182 tpd

Southwest Forest Industries Inc.

SNOWFLAKE, ARIZ.
Pulp—700 tpd kraft; 200 tpd groundwood; 600 tpd deinked news
Newsprint—800 tpd
Kraft linerboard—450 tpd

PANAMA CITY, FLA.
Pulp—660 tpd hardwood or fluff
Linerboard—800 tpd

Total production capacity:

PULP	
Kraft	8,580 tpd
Semichemical	1,450 tpd
Deinked	600 tpd
Groundwood	180 tpd
Total	10,810 tpd

PAPER & BOARD	
Linerboard	7,300 tpd
Corrugating medium	2,420 tpd
Kraft paper	1,965 tpd
Newsprint	800 tpd
Specialty paper/board	118 tpd
Total	12,003 tpd

Stora Kopparbergs Bergslags AB

Newton Falls Paper Mill Inc.
Box 253
Newton Falls, N.Y. 13666
Leif Smedman, president

Stora Forest Industries
Box 59
Port Hawkesbury, N.S. B02 2V0
Tom R. Hall, president/general manager

(Stora reorganized following its acquisition of AB Papyrus, and in 1987 it placed Newton Falls Paper Mill Inc. under the Papyrus fine paper operations umbrella. Stora Forest Industries was made an independent operation. In fall 1987, Newton Falls Paper Mill and Mohawk Paper Mills Inc. formed a cooperation agreement, with each buying a 40% share in the other's mill.)

Financial data not available.

Although the two North American mills operate as separate entities, 1986 combined sales were reported as SKr 1,294 million (about US$204.5 million), and operating income was reported as SKr 80 million (US$12.6 million). In 1987, Stora Forest Industries produced 157,405 metric tons of sulfite market pulp and 141,735 metric tons of newsprint. Newsprint was down from 150,000 metric tons in 1986, due to a shutdown during modernization.

The Newton Falls mill produced 90,768 tons of fine papers.

Newton Falls planned to add No. 1 coated glossy paper to its line in fall 1987 to make up for market share that No. 3 grade is losing to low-cost, high-quality No. 4 grades. At the time of the purchase of shares in Mohawk Paper Mills, Stora announced the partnership mills were engaged in projects to expand capacity to 200,000 tpy of fine paper.

Production facilities:

NEWTON FALLS, N.Y.
(Newton Falls Paper Mill Inc.)
Paper—400 short tpd (363 metric) fine

POINT TUPPER, N.S.
(Stora Forest Industries)
Pulp—440 metric tpd bleached sulfite (for market); 125 tpd high-yield sulfite; 350 tpd groundwood
Newsprint—425 metric tpd

Total production capacity:

PULP (metric tons)	
Sulfite	440 tpd
High-yield sulfite	125 tpd
Groundwood	350 tpd
Total	915 tpd

PAPER (metric tons)	
Newsprint	425 tpd
Fine papers	363 tpd
Total	788 tpd

Temple-Inland Inc.

303 South Temple Drive
Diboll, Texas 75941
Clifford J. Grum, president/chief executive officer of Temple-Inland Inc.
Ben J. Lancashire, executive vice president of Temple-Inland Inc.; president/chairman/chief executive officer of Inland Container Corp.
Joe C. Denman Jr., executive vice president of Temple-Inland Inc.; chairman/president/chief executive officer of Temple-Eastex Inc.

(Temple-Eastex Inc. and Inland Container Corp. are wholly owned subsidiaries of Temple-Inland Inc. In 1987, Mead Corp. and Temple-Inland agreed to dispose of Georgia Kraft Co., in which they had been equal partners, and the sale of the mill at Macon, Ga., to an Australian firm was concluded at mid-year. The Rome, Ga., mill was retained by Temple.)

Net sales:	
1987	$1,602,700,000
1986	1,295,807,000
1985	1,243,100,000
1984	1,262,900,000
Net income:	
1987	141,400,000
1986	80,800,000
1985	85,100,000
1984	102,700,000

Container/containerboard (Inland)

Revenues:	
1987	$964,200,000
1986	721,700,000
1985	684,200,000
1984	665,300,000
Income before taxes:	
1987	150,800,000
1986	38,800,000
1985	49,700,000
1984	74,800,000

Pulp/paperboard (Temple-Eastex)

Revenues:	
1987	$292,500,000
1986	264,900,000
1985	256,700,000
1984	284,500,000
Income before taxes:	
1987	53,400,000
1986	29,400,000
1985	19,800,000
1984	46,800,000

Temple-Inland is a forest resource company with major interests in paper, packaging, building products, mortgage banking, and insurance. In July 1986, it acquired the Orange, Texas, mill (plus other holdings) from Owens-Illinois Inc. A recycled linerboard mill was started at Ontario, Calif., in late 1985. These two events moved T.I., once a converter of all its board, to be a seller as well.

Capacity for linerboard is 1,380,000 tpy (Ontario, Calif.; Rome, Ga.; Orange, Texas), for corrugating medium 480,000 tpy (Newark, Calif.; Newport Ind.; New Johnsonville, Tenn.), and for bleached pulp 565,000 tpy (Evadale, Texas).

Of total Temple-Inland revenues in 1987, Inland accounted for 60% and Eastex for 22%.

Inland makes containerboard and corrugated packaging; its output of linerboard and corrugating medium in 1987 was 1,874,000 tons.

Temple-Eastex (bleached paperboard and building materials) produced 474,000 tons of paperboard and 99,000 tons of bleached pulp in 1987.

Capital expenditures for container and containerboard in 1987 were $68.2 million; for pulp and papermaking operations, expenditures were $22.1 million.

The company owns over 1,700,000 acres of timberlands in the southern U.S. and controls some 100,000 additional acres through long-term leases.

Production facilities:

NEWARK, CALIF.
(Inland Container)
Recycled paperboard—175 tpd

ONTARIO, CALIF.
(Inland Container)
Recycled linerboard—500 tpd

ROME, GA.
(Inland-Rome; former Georgia Kraft Co. mill)
Pulp—4,000 tpd unbleached kraft
Linerboard—4,600 tpd

NEWPORT, IND.
(Inland Container)
Corrugating medium—575 tpd

NEW JOHNSONVILLE, TENN.
(Inland Container)
Pulp—375 tpd semichemical
Corrugating medium—575 tpd

EVADALE, TEXAS
(Temple-Eastex)
Pulp—1,500 tpd bleached kraft
Bleached board—1,500 tpd

ORANGE, TEXAS
Pulp—1,150 tpd unbleached kraft
Linerboard—1,150 tpd

Total production capacity:

PULP	
Kraft	4,650 tpd
Semichemical	375 tpd
Total	5,025 tpd
PAPERBOARD	
Bleached board	1,500 tpd
Linerboard	3,950 tpd
Corrugating medium	1,325 tpd
Total	6,795 tpd

Union Camp Corp.

1600 Valley Rd.
Wayne, N.J. 07470
R.E. Cartledge, chairman/president/chief executive officer

Net sales:	
1987	$2,307,599,000
1986	2,045,215,000
1985	1,865,871,000
1984	1,973,781,000
Net income:	
1987	207,483,000
1986	129,934,000
1985	95,092,000
1984	181,451,000

Union Camp bases its strategy on large-scale integrated mills producing linerboard, kraft paper, and white papers. In addition to pulp and paper, UC has woodlands, converted products, chemicals, building products, and land resources operations. In 1986, it sold its recycled paperboard mill at Monroe, Mich., to Jefferson Smurfit Corp. Union Camp products now include uncoated bond, copy, tablet, duplicating and offset papers; coated and uncoated bristols; kraft paper; linerboard; and saturating kraft.

Paper and board shipments in 1987 were 1,531,937 tons, up from 1,520,178 tons in 1986.

Paper and paperboard contributed $1.317 million toward total sales in 1987, up from $1.269 million in 1986.

Capital spending totaled $181,817 in 1987 ($115,915 for pulp and paper projects). This was down from $209,045 in 1986 ($126,038 for pulp and paper projects). In early 1987, Union Camp announced plans to increase capacity at its Montgomery, Ala., linerboard mill by 400 tpd to 2,400 tpd at a cost of about $188 million, $87 million of it for rebuilding No. 1 machine. The project, which also includes a new woodyard and debarking/chipping system, will take two years to complete.

In 1987, the company was also studying a $200-million modernization of its Savannah, Ga., mill. When the project was approved early in 1988, the restructuring program had increased to $375 million and included a 460,000-tpy linerboard machine; modernization of pulping facilities; shutdown of two older, less efficient machines; and compliance with pulp mill odor emission regulations. Completion is set for 1991.

A possible further expansion is a second uncoated free-sheet paper machine at the Eastover, S.C., mill.

Union Camp owns 1,675,000 acres of timberland and has cutting rights on 77,000 additional acres.

Production facilities:

MONTGOMERY, ALA.
Pulp—2,200 tpd kraft
Linerboard—2,025 tpd

SAVANNAH, GA.
Pulp—2,900 tpd kraft
Linerboard—1,475 tpd
Unbleached paper—1,300 tpd

EASTOVER, S.C.
Pulp—700 tpd bleached kraft
Uncoated free-sheet paper—600 tpd

FRANKLIN, VA.
Pulp—2,000 tpd kraft
Fine, industrial paper/board—2,000 tpd

Total production capacity:

PULP	7,800 tpd
PAPER & BOARD	
Unbleached paper	1,300 tpd
Fine, industrial, paper/board	2,000 tpd
Linerboard	3,500 tpd
Uncoated free-sheet	600 tpd
Total	7,400 tpd

United States Gypsum Co.

(Subsidiary of USG Corp.)
101 S. Wacker Dr.
Chicago, Ill. 60606
Robert J. Day, chairman/president/chief executive officer

Financial data not available.

USG Corp. was organized in January 1985 as the holding company for several operating subsidiaries that manufacture and market products for the building products and industrial processes markets. Gypsum linerboard is included in U.S. Gypsum's Gypsum Products operations, which accounted for 51% of 1987 sales ($1,196 million); insulation board is part of Wood Fiber operations, accounting for 18% of 1987 sales.

Production facilities:

SOUTH GATE, CALIF.
Gypsum board liner—200 tpd
Saturating felt—70 tpd (Mill idle)

JACKSONVILLE, FLA.
Gypsum board liner—190 tpd

NORTH KANSAS CITY, MO.
Gypsum board liner—130 tpd

CAMDEN, N.J.
Gypsum board liner—130 tpd

CLARK, N.J.
Gypsum board liner—396 tpd

OAKFIELD, N.Y.
Gypsum board liner—105 tpd

GYPSUM, OHIO
Gypsum board liner—105 tpd

OAKMONT, PA.
(Mill idle)
Paper—60 tpd bag and grocery sack

GALENA PARK, TEXAS
Gypsum board liner—175 tpd

Total production capacity:

PAPER & BOARD	
Gypsum board liner	1,441 tpd
Saturating felt	70 tpd
Paper	60 tpd
Total	1,561 tpd

Virginia Fibre Corp.

51 Locust Ave.
New Canaan, Conn. 06840
R.C. Macauley, chairman/chief executive officer

(Greif Bros. Corp. has a 50% limited partnership interest in Virginia Fibre.)

Net income:	
1987	$10,448,000
1986	2,935,000
1985	5,000,000
1984	7,900,000

(fiscal year ends Sept. 30)

Virginia Fibre is a major producer of semichemical corrugating medium and in 1986 produced 261,641 tons.

A 1987 capital project saw installation of a new headbox and top wire former on the semichemical medium machine, one of the few such installations on a medium unit.

Production facilities:
(1987 production estimates based on 354 days' operation)

RIVERVILLE, VA
Pulp—560 tpd semichemical; 170 tpd recycled fiber
Semichemical corrugating medium—730 tpd)

Total production capacity:

PULP	730 tpd
PAPERBOARD	730 tpd

Waldorf Corp.

2250 Wabash Ave., Box 43260
St. Paul, Minn. 55114
Gene Frey, president

Net sales:	
1987	$122,222,000
1986	108,092,000
1985	108,259,000
1984	105,525,000
(fiscal year ends June 30)	

Waldorf reappeared as a name in the industry when Trident Associates Inc. bought two mills from Champion International Corp. and created a new company. It chose part of the name of Hoerner Waldorf Corp., which had operated a folding carton division bought by Champion in 1977. Champion had owned the St. Paul, Minn., mill and acquired the Battle Creek, Mich., mill along with St. Regis Corp. In addition to the two mills, Waldorf has six folding carton plants.

In 1987, Waldorf produced 373,493 tons of paperboard, up from 336,741 tons in 1986.

Capital expenditures in 1987 were $1.6 million, down from $1.7 million in 1986. The company is expecting to spend $1.6 million in 1988.

Production facilities:

BATTLE CREEK, MICH.
Recycled board—325 tpd

ST. PAUL, MINN.
Recycled medium—400 tpd
Recycled board—375 tpd

Total production capacity:

Recycled medium	400 tpd
Recycled board	700 tpd

Wausau Paper Mills Co.

One Clark's Island, Box 1408
Wausau, Wis. 54402-1408
William L. Goggins, president/chief executive officer

Net sales:	
1987	$251,371,000
1986	224,751,000
1985	205,466,000
1984	214,146,000
Net income:	
1987	12,047,000
1986	11,502,000
1985	6,803,000
1984	6,578,000
(fiscal year ends Aug. 31)	

Wausau is a manufacturer and marketer of uncoated printing and specialty papers. Of its two units, Brokaw Div. focuses on fine writing, printing, and specialty papers—bristol, bond, offset, and text color papers. The Rhinelander subsidiary makes pressure-sensitive, medical and specialty packaging papers, and translucent paper. The Lake States Div. of Rhinelander produces lignosulfonates and 21,000 lb/day of torula yeast from purchased pulping liquors. The company makes 30% of its own pulp from aspen.

Total output of paper in 1987 was over 238,000 tons, up 8% from 1986.

Wausau capital expenditures in 1987 totaled about $12 million, bringing the four-year figure to $41 million. In 1986, $4.5 million was spent on Brokaw's pulp and acid plant in an ongoing modernization plan, and $3 million was spent at Rhinelander on a paper machine upgrade.

Wausau will spend $40 million to rebuild No. 7 specialty paper machine at Rhinelander, Wis., in order to increase capacity by 25,000 tpy. Capacity on No. 9 will also be increased about 10%. At Brokaw, Wis., the pulp mill will be expanded and modernized, with capacity increasing from 75,000 tpy to 86,600 tpy of bleached sulfite pulp.

Wausau owns 43,400 acres of timberland in Wisconsin.

Production facilities:

BROKAW, WIS.
(Brokaw Div.)
Pulp—220 tpd sulfite
Fine and specialty paper—440 tpd

RHINELANDER, WIS.
(Rhinelander Paper Co.)
Lightweight, dense technical specialty papers—300 tpd

Total production capacity:

PULP	220 tpd
PAPER	740 tpd

Weldwood of Canada Ltd.

1055 W. Hastings St., Box 2179
Vancouver, B.C. V6B 3V8
Thomas Buell, chairman/president

[In early 1988, Weldwood got approval from shareholders to purchase Champion International Corp.'s St. Regis Paper Co. (Canada) Ltd., which included Champion Forest Products (Alberta) Ltd. (of which the Hinton, Alta., market pulp mill is a part) and St. Regis Resources Ltd. (oil and gas). In exchange, Champion's share in Weldwood was boosted from 71.8% to 84.6%. Weldwood owns 50% of Cariboo Pulp & Paper Co.; Daishowa-Marubeni International Ltd. owns 50%.]

Net sales (C$):	
1987	$741,035,000
1986	658,946,000
Net income (C$):	
1987	47,592,000
1986	30,037,000

Champion had begun a pulp expansion project at the Hinton, Alta., mill to increase bleached softwood kraft pulp output from 210,000 metric tpy to 424,000 metric tpy. The C$361-million project is scheduled for late 1989 startup.

Production facilities:

HINTON, ALTA.
Pulp—545 metric tpd kraft (for market)

QUESNEL, B.C.
(Cariboo Pulp & Paper Co.)
Pulp—800 metric tpd bleached kraft
(Weldwood's share: 400 tpd)

Total production capacity:

PULP	945 metric tpd

Western Pulp Limited Partnership

(Sub. of Western Forest Products Ltd.)
1300-355 Burrard St.
Vancouver, B.C. V6C 2G8
Chester A. Johnson, chairman/chief executive officer

[Operated by Western Pulp Inc., which is owned by British Columbia Forest Products Ltd. (20.1%), Doman Industries Ltd., and International Forest Products Ltd. (formerly Whonnock Industries Ltd.).]

Net sales (C$):	
1987	$258,213,000
1986	182,100,000
1985	109,759,000
1984	128,541,000

Net earnings (C$)	
1987	28,499,000
1986	-11,200,000
1985	-35,972,000
1984	-1,029,000

Total production at WPLP mills in 1987 was 370,180 metric tons, up from 320,000 metric tons in 1986. Of the 1987 tonnage, 156,330 tons were produced at Port Alice and 213,850 tons were produced at Squamish. Planned output for 1988 is 230,000 metric tons for Squamish and 158,000 metric tons for Port Alice.

A modernization program at the Squamish mill was completed in 1986 and increased production to 215,000 metric tpy. A smaller upgrade to improve reliability, pulp quality, and environmental features was completed at Port Alice, B.C.

Capital expenditures totaled C$34 million in 1986 and C$14.9 million in 1987. More than $30 million will be spent on the mills in 1988.

Production facilities:

PORT ALICE, B.C.
Pulp—450 metric tpd sulfite dissolving and specialty (for market)

SQUAMISH (Woodfibre), B.C.
Pulp—600 metric tpd bleached kraft (for market)

Total production capacity:

PULP	1,050 metric tpd

Westvaco Corp.

299 Park Ave.
New York, N.Y. 10171
David L. Luke III, chairman/chief executive officer

Net sales:	
1987	$1,903,606,000
1986	1,811,937,000
1985	1,721,783,000
1984	1,766,267,000
Net income:	
1987	146,191,000
1986	108,096,000
1985	104,625,000
1984	129,974,000

(fiscal year ends Oct. 31)

Westvaco has been emphasizing higher-value-added differentiated products and has one of the highest research and development budgets in the industry—more than $23 million in 1986. Examples of new products include new papers for high-quality printing and the graphic arts, bleached paperboard to replace glass or plastic packaging, and saturating kraft used in decorative laminates.

Westvaco manufactures a broad range of high-quality papers for quality graphic reproduction, communications, and packaging in the U.S., and it also has packaging interests in Brazil. It is a major manufacturer of consumer and industrial packaging and one of the world's largest producers of envelopes. It also produces specialty chemicals and develops land for commercial and residential use.

The company produced 82,177 tons of pulp in 1986 and 2,268,965 tons of paper and paperboard.

Sales of bleached pulp, paper, and paper products were $1,139.4 million in 1987, and unbleached paper and products sales were $544.4 million.

Capital expenditures in 1987 were $297.6 million, up from $250.4 million in 1986. In 1987, $163 million was spent on bleached pulp, paper, and paper products, and $98.5 million was spent on unbleached paper and products.

Westvaco owns 1,369,000 acres of timberland in U.S.

Production facilities:

WICKLIFFE, KY
(Fine Papers Div.)
Pulp—932 tpd bleached kraft
Fine papers—550 tpd

LUKE, MD
(Fine Papers Div.)
Pulp—1,050 tpd bleached kraft
Fine papers—1,375 tpd

TYRONE, PA
(Fine Papers Div.)
Fine papers—200 tpd

CHARLESTON, S.C.
(Kraft Div.)
Pulp—2,594 tpd unbleached kraft
Paperboard—2,400 tpd

COVINGTON, VA
(Bleached Board Div.)
Pulp—1,812 tpd kraft (1,605 tpd bleached); 207 tpd semichemical
Paperboard—1,567 tpd
Corrugating medium—333 tpd

Total production capacity:

PULP	
Kraft	6,181 tpd
Semichemical	207 tpd
Total	6,688 tpd

PAPER & BOARD	
Fine papers	2,125 tpd
Corrugating medium	213 tpd
Paperboard	3,967 tpd
Total	6,425 tpd

Weyerhaeuser Co.

Tacoma, Wash. 98477
George H. Weyerhaeuser, president/chief executive officer

(Weyerhaeuser Canada Ltd. is a wholly owned subsidiary. Weyco owns 90% of North Pacific Paper Corp.; Jujo Paper Co. Ltd. of Japan owns 10%.)

Net sales:	
1987	$6,989,829,000
1986	5,652,029,000
1985	5,205,579,000
1984	5,549,738,000
Net income:	
1987	446,623,000
1986	276,685,000
1985	200,116,000
1984	226,187,000

Weyerhaeuser Forest Products Co., Weyerhaeuser Paper Co., and Weyerhaeuser Real Estate Co. are the three main sectors of Weyerhaeuser Co., following reorganization in 1985. Company strategy is to continue to diversify, while at the same time strengthening the traditional wood products and paper businesses.

The Pine Bluff, Ark., unbleached kraft paper mill was sold to Mid-America Packaging Inc. early in 1986.

In September 1986, Weyerhaeuser Canada bought the 280,000-metric-tpy Prince Albert Pulp Co. Ltd. bleached kraft market pulp mill at Prince Albert, Sask. Investment plans for this mill include pulp mill expansion to 337,000 metric tpy by 1990 and installation of a 200,000-metric-tpy uncoated free-sheet paper machine for startup the same year.

Weyerhaeuser Paper Co. is the world's largest exporter of pulp and paper. With a production capacity of over five million tpy, it is among the top pulp and paper producers. Paper Co. sales totaled $2.9 billion in 1987, up from $2.3 billion in 1986, and operating earnings were $522.4 million.

Contributions to total sales in 1987 were pulp, $704 million; newsprint, $304 million; paper, $494 million; paperboard and containerboard, $295 million.

Output of pulp reached 1,368,000 metric tons in 1987; newsprint, 468,000 metric tons; paper, 716,000 short tons; paperboard, 179,000 short tons; and containerboard, 2,057,000 short tons.

Paper Co. capital expenditures in 1987 were $308,404, down from $350,917 in 1986. Early in 1988, the company announced an $8.5-million project on a corrugating medium machine at the North Bend, Ore., mill and another project at Springfield, Ore. Both will increase containerboard incrementally. A $400-million, 425,000-tpy kraft pulp line for the Columbus, Miss., mill was given a green light in spring 1988.

Weyerhaeuser has fee ownership of 5,871,000 acres of commercial forestland in the U.S., roughly divided between the South and the Northwest, and long-term licensing arrangements for 12,064,000 acres in Canada.

Production facilities:

COLUMBUS, MISS.
Pulp—260 tpd thermomechanical
Lightweight coated paper—500 tpd

NEW BERN, N.C.
Pulp—725 tpd bleached kraft (for market)

PLYMOUTH, N.C.
Pulp—970 tpd kraft (264 for market), 220 tpd semichemical
Containerboard—1,020 tpd
Fine papers—930 tpd

VALLIANT, OKLA.
Pulp—1,600 tpd kraft, 400 tpd semichemical
Linerboard—1,980 tpd
Corrugating medium—570 tpd

NORTH BEND, ORE.
Pulp—300 tpd semichemical
Corrugating medium—470 tpd

SPRINGFIELD, ORE.
Pulp—1,090 tpd kraft
Containerboard—1,400 tpd

COSMOPOLIS, WASH.
Pulp—450 tpd sulfite (for market)

EVERETT, WASH.
Pulp—395 tpd kraft (for market)

LONGVIEW, WASH.
Pulp—750 tpd kraft (some for market); 200 tpd semichemical
Corrugating medium—255 tpd
Bleached paperboard—540 tpd

LONGVIEW, WASH.
(North Pacific Paper Co.)
Pulp—1,450 tpd thermomechanical
Newsprint—1,300 tpd

LONGVIEW, WASH.
(R-W Paper Co.)
Fine paper—360 tpd

ROTHSCHILD, WIS.
Pulp—210 tpd sulfite
Fine paper—320 tpd

KAMLOOPS, B.C.
(Weyerhaeuser Canada Ltd.)
Pulp—1,135 metric tpd (1,250 short) kraft (for market)

PRINCE ALBERT, SASK.
(Prince Albert Pulp & Paper, div. of Weyerhaeuser Canada Ltd.)
Pulp—900 metric tpd (992 short) bleached kraft (for market)

Total production capacity:

PULP	
Kraft	7,657 tpd
Semichemical	1,120 tpd
Sulfite	660 tpd
TMP	1,710 tpd
Total	11,147 tpd
PAPER & BOARD	
Fine paper	1,610 tpd
LWC paper	500 tpd
Newsprint	1,300 tpd
Bleached paperboard	540 tpd
Linerboard	1,980 tpd
Corrugating medium	1,295 tpd
Containerboard	1,420 tpd
Total	8,645 tpd

Willamette Industries Inc.

3800 First Interstate Tower
1300 S.W. Fifth Ave.
Portland, Ore. 97201
William Swindells, president/chief executive officer

Net sales:	
1987	$1,431,624,000
1986	1,200,155,000
1985	1,152,067,000
1984	1,181,910,000
Net earnings:	
1987	121,339,000
1986	74,665,000
1985	60,244,000
1984	61,021,000

Willamette is a producer of containerboard, kraft paper, uncoated free-sheet, and market pulp. Most of its production is converted at its own plants into corrugated boxes, kraft sacks, and business forms. In addition, the company manufactures lumber, plywood, and particleboard.

Willamette's pulp and paper sales were about $246 million in 1987, 17% of total sales, up from $208 million in 1986.

In 1987, total pulp and paper production was 1,364,000 tons, close to company capacity of 1,366,000 tons.

Total capital expenditures in 1987 were $128.8 million, down from $243.2 million in 1986. No. 3 corrugating medium machine in Albany, Ore., was converted to multi-ply linerboard and came online in late 1987. At Campti, La., a similar modernization will be completed in 1988, increasing capacity to 60,000 tpy.

Capacity for bleached hardwood pulp at the Hawesville, Ky., mill will be increased from 700 tpd to 735 tpd.

Early in 1988, Willamette announced that it would build a 200,000-tpy uncoated free-sheet paper mill near Bennettsville, S.C., for 1990 startup. Initially, the mill will have capacity for 625 tpd of forms bond and copy papers on one machine, and eventually it will be rated for 1,250 tpd.

Willamette owns 892,000 acres of timberland in the U.S.

Production facilities:

PORT HUENEME, CALIF.
Recycled paperboard (corrugating medium, linerboard)—370 tpd

HAWESVILLE, KY.
(Kentucky Mills: bleached pulp, fine paper)
Pulp—675 tpd bleached hardwood kraft (350 tpd for market)

HAWESVILLE, KY.
(Kentucky Mills: corrugating medium)
Pulp—300 tpd semichemical
Corrugating medium—365 tpd

HAWESVILLE, KY.
(Kentucky Mills: fine paper)
Fine paper—500 tpd

CAMPTI, LA.
(Red River Mill Div.)
Pulp—800 tpd unbleached kraft
Kraft linerboard—930 tpd

ALBANY, ORE.
Pulp—580 tpd kraft; 200 tpd semichemical
Kraft linerboard, paper—900 tpd
Corrugating medium—285 tpd

Total production capacity:

PULP	
Kraft	2,055 tpd
Semichemical	500 tpd
Total	2,555 tpd
PAPER & BOARD	
Fine paper	500 tpd
Kraft linerboard, paper	1,830 tpd
Corrugating medium	650 tpd
Recycled linerboard, medium	370 tpd
Total	3,350 tpd

OTHER FIRMS (under 1,000-tpd capacity)

A listing of U.S. and Canadian pulp and paper companies with daily production capacities under 1,000 short tons (U.S.) or 900 metric tons (Canada).

APL Corp.
6917 Collins Ave.
Miami Beach, Fla. 33141
Victor Posner, chairman/president/chief executive officer

Production facilities:

FLAGSTAFF, ARIZ.
(Ponderosa Paper Products Concel Inc., Div. of Cancel Inc.)
Pulp—100 tpd deinked
Paper—80 tpd toweling, 50 tpd napkin

PRYOR, OKLA.
(Robel Tissue Mills Inc.)
Pulp—100 tpd deinked
Paper—100 tpd tissue

ST. HELENS, ORE.
(Concel Inc., machine in Boise Cascade Corp. mill)
Paper—125 tpd tissue, toweling, wadding

Total production capacity:

Pulp	200 tpd
Paper	355 tpd

Alaska Pulp Corp.
(Sub. of Alaska Pulp Co. Ltd., Japan)
3000 Rainier Bank Tower
Seattle, Wash. 98101
George Ishiyama, chairman

Production facilities:

SITKA, ALASKA
Pulp—600 tpd alpha/dissolving sulfite (for market)

Alberta Newsprint Co. Ltd.
2130 West 12th Ave.
Vancouver, B.C. V6K 2N3
Ronald N. Stern, managing director
Harry L. Thompson, vice president, operations

This C$360-million greenfield mill near Whitecourt, Alta., will be Alberta's first newsprint mill and will produce 120,000 metric tpy of paper in 1990, the year of its startup, with output rising to 180,000 tpy in 1992 and eventually to 220,000 tpy. Chemi-thermomechanical pulp will be made from a mix of 80% softwood and 20% hardwood. A head office will be established in Edmonton, Alta.

Allied Paper Products Inc.
(Sub. of Hanson Trust plc, U.K.)
2 Prestige Place, Suite 360
Miamisburg, Ohio 45342
W.H. Ames, president

(The Jackson, Ala., mill was sold to Boise Cascade Corp. in June 1986.)

Production facilities:

KALAMAZOO, MICH.
Paper—415 tpd forms, computer, writing, file folder, envelope

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Alpha Cellulose Corp.
1000 E. Noir St., Box 1305
Lumberton, N.C. 28359
J.E. Wilkinson, president

Production facilities:

LUMBERTON, N.C.
Pulp—140 tpd cotton linters, specialty (for market)

American Fibrit Inc.
(Div. of Deutsch Fibrit, Fed. Rep. Germany)
76 Armstrong Rd.
Battle Creek, Mich. 49015
Jan Mueller, president

Production facilities:

BATTLE CREEK, MICH.
Pulp—6 tpd thermomechanical

American Paper Products Co.
2113-31 E. Rush St.
Philadelphia, Pa. 19134
L.J. Perelman, partner

Production facilities:

LANCASTER, PA.
Paperboard—50 tpd chipboard, newsboard, specialty board, tub stock

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American Tissue Co.
185 Price Parkway
Farmingdale, N.Y. 11735
Yahya Gabayzadeh, president

(Former Diamond International Corp., then Packaging Corp. of America mill. Idle since 1983; no startup date announced.)

Production facilities:

NATCHEZ, MISS.
Paper—household tissue

Ashuelot Paper Co.
(Div. of Parker-Pace Corp.)
Box 26
Hinsdale, N.H. 03451
Ian Smith, president/general manager

Production facilities:

HINSDALE, N.H.
Paper—50 tpd tissue, toweling, creping, wrapping, specialties

PUTNEY, VT.
(Putney Paper Co.)
Paper—40 tpd tissue, creping, florist

Total production capacity:

Paper	90 tpd

Atlantic Packaging Products Ltd.
111 Progress Ave.
Scarborough, Ont. M1P 2Y9
Phillip Granovsky, chairman

Early in 1988, Atlantic announced it was building a 150,000-metric-tpy recycled newsprint machine and 35,000-tpy tissue machine on a greenfield site at Whitby, Ont., with tissue production scheduled to start early in 1989 and newsprint about a year later.

Production facilities:

SCARBOROUGH, ONT.
Pulp—60 metric tpd deinking
Paper—60 metric tpd tissue
Paperboard—400 metric tpd linerboard or 300 metric tpd medium

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Atlas Paper Mills Corp.
3725 E. 10 Court
Hialeah, Fla. 33013
Remberto Bastanzuri, president

Early in 1988, Atlas began a $3.8 million project to install additional converting equipment, preparatory to adding a second recycled tissue machine.

Production facilities:

HIALEAH, FLA.
Paper—30 tpd recycled tissue

Badger Paper Mills Inc.
W. Front St., Box 149
Peshtigo, Wis. 54157
Edwin A. Meyer Jr., chairman/chief executive officer

Production facilities:

PESHTIGO, WIS.
Pulp—165 tpd bleached sulfite
Paper—165 tpd fine and coarse

Banner Fibreboard Co.
Box 390
Wellsburg, W.Va. 26070
F.L. Bush, president

Production facilities:

WELLSBURG, W.VA.
Paperboard—70 tpd tube stock, specialty boards, linerboard

Beloit Box Board Co. Inc.
801 2nd St., Box 386
Beloit, Wis. 53511
Joseph H. Chamberlain, president

Production facilities:

BELOIT, WIS.
Paperboard—51 tpd boxboard, chipboard, can and tube stock

Bennett Fleet Inc.
2700 Bourgogne St.
Chambly, Que. J3L 4B6
Ralph G. Fleet, president

Production facilities:

CHAMBLY, QUE.
Paperboard—27 metric tpd binders board, packaging, specialties

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Bio-Tech Mills Inc.
Route 29
Greenwich, N.Y. 12834
Marvin Ferris, president/general manager

Production facilities:

BATTENVILLE, N.Y.
Pulp—12 tpd deinked
Paper—10 tpd tissue

Brandywine Paper Mills Inc.
131 Wallace Ave.
Downingtown, Pa. 19335
Robert M. McIlvain Sr., president

Production facilities:

DOWNINGTON, PA.
Paperboard—50 tpd chipboard, recycled board

Brown Products Inc.
One Pine St.
Nashua, N.H. 03060
Austin Barrett, chairman

Production facilities:

NASHUA, N.H.
Paperboard—6 tpd corrugating medium

Building Products of Canada Ltd.
(Sub. of Imperial Oil Ltd.)
10500 Côte de Liesse
Lachine, Que. H8T 3E3
P.J. Levins, president

Production facilities:

EDMONTON, ALTA.
Gypsum linerboard—90 metric tpd

PONT ROUGE, QUE.
Pulp—160 metric tpd refiner mechanical; 220 metric tpd thermomechanical
Board—260 metric tpd impregnation

Total production capacity:

Pulp	380 metric tpd
Paperboard	350 metric tpd

Burrows Paper Corp.
501 E. Main St.
Little Falls, N.Y. 13365-0987
Ralph W. Burrows Jr., president/chief executive officer

Production facilities:

PICKENS, MISS.
(Burrows Southern Corp.)
Paper—20 tpd wrapping, specialty tissue

LITTLE FALLS, N.Y.
Paper—45 tpd carbonizing, napkin, pattern, wrapping, specialty tissue

LITTLE FALLS, N.Y.
(Mohawk Valley Paper Co. Inc.)
Paper—30 tpd carbonizing, napkin, pattern, wrapping, specialty tissue

LYONSDALE, N.Y.
Paper—30 tpd carbonizing, napkin, pattern, wrapping, specialty tissue

Total production capacity:

Paper	125 tpd

CPM Inc.
Box 388
West Lebanon, N.H. 03784
Harvey D. Hill, chairman/chief executive officer

Production facilities:

CLAREMONT, N.H.
Paper—60 tpd special and industrial

EAST RYEGATE, VT.
Paper—60 tpd special and industrial

Total production capacity:

Paper	120 tpd

Cellu Products
(Div. of Sealed Air Corp.)
Box 98, River Road
Patterson, N.C. 28661
W.V. Hickey, vice president/general manager

Production facilities:

PATTERSON, N.C.
Paper—20 tpd tissue, wadding

Cellu Tissue Corp.
2 Forbes St.
East Hartford, Conn. 06108
William Dodenhoff, chairman/chief executive officer

Production facilities:

EAST HARTFORD, CONN.
Paper—55 tpd tissue, wadding

Celotex Corp.
(Sub. of Jim Walter Corp.)
Box 22601
Tampa, Fla. 33622
Frank Burgen, president, Celotex

Production facilities:

QUINCY, ILL.
Gypsum board liner—300 tpd

Chase Bag Co.
2 Greenwich Plaza
Greenwich, Conn. 06830
F.H. Ludington Jr., chairman

Production facilities:

CHAGRIN FALLS, OHIO
(Paper Mill Div.)
Paper—62 tpd bag and sack, filter, stamp, toweling, specialties

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Cheney Pulp & Paper Co.
1000 Anderson St.
Franklin, Ohio 45005
James H. Snyder, president

Production facilities:

FRANKLIN, OHIO
Pulp—24 tpd flax, rag, cotton, hemp

Chesapeake Paperboard Co.
Fort Ave. & Woodall Sts.
Baltimore, Md. 21230
C.J. Smith, president

Production facilities:

BALTIMORE, MD.
Paperboard—250 tpd boxboard, chipboard, laminating, manila

ChinAm Inc.
(Morris Paperboard Div.)
177 Third Ave.
Paterson, N.J. 07509
Ji Xing, associate president/general manager
(Owned 100% by National Packaging Corp., People's Rep. China)

Production facilities:

PATERSON, N.J.
(Former Morris Paper Board Co. mill)
Paperboard—100 tpd white-lined folding boxboard

Cleaners Hanger Co.
670 17th St., N.W.
Massillon, Ohio 44646
Dennis Mele, president

Production facilities:

MASSILLON, OHIO
Paperboard—80 tpd chipboard, containerboard, corrugating medium

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Climax Mfg. Co.
Castorland, N.Y. 13620
Charles S. Hirschey, chairman

Production facilities:

CARTHAGE, N.Y.
(Paperboard Div.)
Paperboard—125 tpd boxboard, foodboard, specialties

Clinch River Corp.
Emory St.
Harriman, Tenn. 37748
Joseph G. Donohoo, president

(Formerly Harriman Paperboard Corp., one of bankrupt Lawrence Paperboard Corp.'s mills. Consolidated Packaging Corp. withdrew an offer to purchase the mill in 1986 because of existing water quality problems. Clinch River Corp. was formed to buy the mill. Mill was scheduled to restart in spring 1988.)

Production facilities:

HARRIMAN, TENN.
Paperboard—300 tpd semichemical medium

Columbia Corp.
Box 330
Chatham, N.Y. 12037
James L. Salerno, president/treasurer

Production facilities:

CHATHAM, N.Y.
Paperboard—100 tpd binders board, boxboard, chipboard, specialty

NORTH HOOSICK (Walloomsak), N.Y.
Paperboard—100 tpd boxboard, specialty board

Total production capacity:

Paperboard 200 tpd

Connelly Containers Inc. of Philadelphia
(Sub. of Connelly Containers Inc.)
4368 Main St.
Philadelphia, Pa. 19127
J. Donahue, president

Production facilities:

PHILADELPHIA, PA.
Paperboard—125 tpd corrugating medium, recycled linerboard

Consolidated Packaging Corp.
333 West Lake St.
Chicago, Ill. 60606
Andre Holtzman, president/chief executive officer

Production facilities:

FORT MADISON, IOWA
Pulp—150 tpd semichemical
Paperboard—200 tpd corrugating medium

Contoocook Valley Paper Co.
190 Charles St.
Rochester, N.H. 03867
Frederic H. Fletcher, president/treasurer

Production facilities:

WEST HENNIKER, N.H.
Paperboard—20 tpd latex paper and board, shoeboard, specialties

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Converters Paperboard Inc.
(Div. of Midwest Folding Carton Inc.)
7734 Childsdale Rd.
Rockford, Mich. 49341

Production facilities:

ROCKFORD, MICH.
(Former RPM Board & Carton Corp. mill)
Paperboard—100 tpd boxboard, chipboard, folding boxboard

Cornwall Paper Mills Co.
300 Executive Dr., Suite 360
West Orange, N.J. 07052
Thomas G. San Giacomo, chief executive officer

Production facilities:

CORNWALL, N.Y.
Paperboard—200 tpd corrugating medium

Corrugated Services Inc.
On Interstate 20
Forney, Texas 75126
Jones Felvey, president

(A project to expand capacity to about 230 tpd is planned for 1989 completion.)

Production facilities:

FORNEY, TEXAS
Paperboard—180 tpd corrugating medium

Cottrell Paper Co. Inc.
Rock City Falls, N.Y. 12863
J. Thomas Cottrell Jr., president

Production facilities:

ROCK CITY FALLS, N.Y.
Paperboard—6 tpd electrical insulating

Coy Paper Co.
Claremont, N.H. 03743
Hans Unander-Scharin, president

Production facilities:

CLAREMONT, N.H.
Paper—19 tpd pattern, twisting tissue

Crane & Co. Inc.
30 South St.
Dalton, Mass. 01226
B.J. Sullivan, chairman/president/chief executive officer

Production facilities:

DALTON, MASS.
(Bay State Mill)
Paper—40 tpd banknote, bond, papeterie, wedding bristols

DALTON, MASS.
(Byron Weston Co.)
Paper—40 tpd bond, bristols, forms, fine, printing/writing, specialties

DALTON, MASS.
(Pioneer Mill)
Paper—25 tpd fine papers, bond

DALTON, MASS.
(Wahconah Mill)
Paper—50 tpd printing, banknote

DALTON, MASS.
(Waconah No. 2, formerly Old Berkshire mill)
Paper—15 tpd banknote

Total production capacity:

Paper	170 tpd

Crestbrook Forest Industries Ltd.
(Pulp Div.)
220 Cranbrook St. N.
Cranbrook, B.C. V1C 3R2
Sakae Hosaka, chairman/chief executive officer

(Owned 32.24% each by Honshu Paper Co. Ltd. and Mitsubishi Paper Mills Ltd. of Japan.)

Production facilities:

SKOOKUMCHUCK, B.C.
Pulp—600 metric tpd bleached kraft (for market)

Crocker Technical Papers Inc.
431 Westminster St.
Fitchburg, Mass. 01420
Richard P. Cuminale, chairman/president

Production facilities:

FITCHBURG, MASS.

Paper—25 tpd capacitor, electrical insulating

Crystal Tissue Co.
3120 S. Verity Pkwy., Box 449
Middletown, Ohio 45042-0449
James F. Akers, president

Production facilities:

MIDDLETOWN, OHIO
Paper—80 tpd filter, specialty tissue

The Davey Co.
164 Laidlaw Ave.
Jersey City, N.J. 07306
W.A. Dodd, chairman/secretary

Production facilities:

AURORA, ILL.
(Aurora Paper Board Div.)
Paperboard—100 tpd binders board, cover, mill boards, specialty

JERSEY CITY, N.J.
Paperboard—100 tpd specialty board, binders board; mill board

DOWNINGTOWN, PA.
(The Davey Co. of Penna)
Paperboard—70 tpd binders board, specialty board, template board, pattern

Total production capacity:

Paperboard	270 tpd

Detroit River Paper Co.
(Sub. of Kapaco Group)
8125 West Jefferson Ave.
Detroit, Mich. 48209
William Walsh, vice president/general manager

Production facilities:

DETROIT, MICH.
(Former Port Huron Paper Corp., Pentair Inc., mill)
Paper—180 tpd lightweight packaging

C.H. Dexter Corp.
(Dexter Div.)
2 Elm St.
Windsor Locks, Conn. 06096
James T. Mayerhofer, president

Production facilities:

WINDSOR LOCKS, CONN.
Pulp—60 tpd hemp
Paper—65 tpd capacitor, condenser, filter, cigarette, laminating, specialty

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Diamond Fiber Products Inc.
Church St., Box 627
Thorndike, Mass. 01079
Robert E. Arnold, president

Production facilities:

THORNDIKE, MASS.
Molded pulp products

Dong Bang
Ocean Falls, B.C.

Korean firm studying 82,000-tpy neutral sulfite anthraquinone market pulp mill.

EHV-Weidmann Industries Inc.
(Sub. of Elcon Inc.)
Memorial Drive
Saint Johnsbury, Vt. 05819-0903
Gordon P. Mills, chairman

Production facilities:

SAINT JOHNSBURY, VT.
Paperboard—60 tpd insulation

Eastman Kodak Co.
1669 Lake Ave.
Rochester, N.Y. 14650
Gordon A. Dyke, manager-sensitized components manufacturing

Production facilities:

ROCHESTER, N.Y.
Paper—photographic base

Equitable Bag Co. Inc.
(Sub. of Triangle Industries Inc.)
37-11 35th Ave.
Long Island City, N.Y. 11101
Leonard E. Canno, chairman/chief executive officer

Production facilities:

ORANGE, TEXAS
Paper—100 tpd bag

Erving Paper Mills
1 Arch Street
Erving, Mass. 01344
Charles B. Housen, president

(In late 1987, Erving and employees of the Fox Paper Div. were negotiating an employee buyout of the mill at Lockland, Ohio, following announcement that the mill would be closed. However, the financing could not be arranged, and the mill was put up for sale in spring 1988.)

Production facilities:

BALDWINVILLE, MASS.
(Baldwinville Products Inc.)
Paper—120 tpd toweling

ERVING, MASS.
(Erving Mill)
Paper—110 tpd napkin tissue

HINSDALE, N.H.
(Hinsdale Products Co. Inc.)
(Mill idle)
Pulp—30 tpd deinking
Paper—33 tpd tissue

LOCKLAND, OHIO
(Fox Paper Div.)
Paper—110 tpd coarse and tissue

Total production capacity:

Pulp	30 tpd
Paper	373 tpd

Esleeck Mfg. Co. Inc.
Canal St.
Turners Falls, Mass. 01376
William C. Blanker, president

Production facilities:

TURNERS FALLS, MASS.
Pulp—rags
Paper—20 tpd thin, technical specialty

Evanite Fiber Corp.
1115 S.E. Crystal Lake Dr.
Corvallis, Ore. 97333
Peter H. Koehler, executive vice president

(In early 1988, EFC Acquisition Inc., a unit of Forsch Corp., agreed to purchase Evanite from DWG Corp., subject to approval by directors and others.)

Production facilities:

CORVALLIS, ORE.
Paper—15 tpd special industrial

Exton Paper Manufacturers Inc.
500 E. Lincoln Highway
Exton, Pa. 19341
Richard H. Darnell, executive vice president

Production facilities:

EXTON, PA.
Cellulose wadding—20 tpd

MODENA, PA.
(Valley Paper Mill)

Paper—60 tpd bag, wrapping

FSC Paper Corp.
13101 S. Pulaski Rd.
Alsip, Ill. 60658
Harry L. Thompson, managing director

(Mill purchased in first-half 1987 by Smorgon Consolidated Industries Pty. Ltd. of Australia from Interscope Holdings Corp., which had 80% ownership, and from Media General Inc., which had 20%; the latter formerly reported the mill along with its Garden State Paper Co.)

Production facilities:

ALSIP, ILL.
Pulp—360 tpd deinked
Paper—315 tpd newsprint

Fibre Form Corp.
722 S. Main Street
Columbia City, Ind. 46725
R.M. Brennan, president

Production facilities:

COLUMBIA CITY, IND.
Molded pulp products

Fibreco Export Inc.
1209 McKeen Ave.
North Vancouver, B.C. V7P 3H9
Anthony Jarrett, president

(Mill under construction; startup late 1988.)

Production facilities:

TAYLOR, B.C.
Pulp—507 metric tpd bleached chemi-thermomechanical (for market)

Filter Materials Inc.
1401 Ware St., Box 329
Waupaca, Wis. 54981
John H. Gusmer, president/general manager

Production facilities:

WAUPACA, WIS.
Pulp—12 tpd rag
Paper—12 tpd filter, impregnating, rag specialties, calender roll fillings

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Filtration Sciences Corp.
105 W. 45th St.
Chattanooga, Tenn. 37409
Edward A. Leinss, president/chief executive officer

Production facilities:

MADISONVILLE, KY.
(Southern Specialty Paper Co.)
Paper—40 tpd special industrial, filter

WATERTOWN, N.Y.
(Eaton-Dikeman Div.)
Paper—20 tpd special industrial, filter, saturating, leather substitute

MOUNT HOLLY SPRINGS, PA.
(Eaton-Dikeman Div.)
Paper—12 tpd special industrial filter, technical, wet strength

CHATTANOOGA, TENN.
(Southern Specialty Paper Co.)
Paper—15 tpd special industrial

Total production capacity:

Paper	87 tpd

Finch, Pruyn & Co.
1 Glen St.
Glen Falls, N.Y. 12801
Richard J. Carota,
chairman/president/chief executive officer

Production facilities:

GLEN FALLS, N.Y.
Pulp—350 tpd ammonium base bisulfite
Paper—575 tpd fine papers

Fletcher Paper Co.
318 Fletcher St.
Alpena, Mich. 49707
Charles S. White, president

Production facilities:

ALPENA, MICH.
Paper—85 tpd lightweight offset, label, map, filter, specialty

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Flower City Tissue Mills Co.
700 Driving Park Ave., Box 13497
Rochester, N.Y. 14613-0497
W.F. Shafer III, president/general manager

Production facilities:

FULTON, N.Y.
(North End Paper Co.)
Paper—8 tpd pattern, waxing and wrapping tissue

ROCHESTER, N.Y.
Paper—22 tpd specialty and wrapping tissue, kraft anti-tarnish

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J. Ford & Co. Ltd.
Portneuf, Que. G0A 2Y0
J.B. Ford, president

Production facilities:

PORTNEUF, QUE.
Paper—80 metric tpd kraft, tissue

Fort Orange Paper Co. Inc.
1900 River Rd.
Castleton-on-Hudson, N.Y. 12033
David Little, president

Production facilities:

CASTLETON-on-HUDSON, N.Y.
Paperboard—110 tpd folding boxboard

Fox River Paper Co.
(Div. of Fox Valley Corp.)
200 E. Washington St., Suite 300
Appleton, Wis. 54913
Harold L. Ellsworth, president

(Acquired Rising Paper Co. in 1988.)

Production facilities:

APPLETON, WIS.
Paper—90 tpd fine papers, printing/writing, technical, specialty

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French Paper Co.
100 French St., Box 398
Niles, Mich. 49120
J.E. French, chairman

Production facilities:

NILES, MICH.
Paper—60 tpd fine, specialty, text

Fripp Fibre Forms Inc.
1350B Spruce St.
Winnipeg, Man. R3E 2V7
Brian Fripp, president

Production facilities:

TISDALE, SASK.
Molded pulp products—14 metric tpd

Georgia Bonded Fibers Inc.
Rte. 60
Buena Vista, Va. 24416
James C. Kostelni, president

Production facilities:

BUENA VISTA, VA.
Paperboard—35 tpd specialty

W.R. Grace & Co.
(Polyfibron Div.)
Rte. 60 E.
Owensboro, Ky. 42301
John Hirsch, president-paper group

Production facilities:

OWENSBORO, KY.
Paper—35 tpd absorbent, converting, impregnating, saturating, specialty

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Greif Board Corp.
(Sub. of Greif Bros. Corp.)
9420 Warmington St. S.W., Box 553
Massillon, Ohio 44646
William R. Shew, president

(Greif Bros. Corp. is an important shareholder in Virginia Fibre Corp.)

Production facilities:

MASSILLON, OHIO
Paperboard—250 tpd chipboard, linerboard, corrugating medium

Groveton Paper Board Inc.
Mechanic St.
Groveton, N.H. 03582
J.W. Griffith, manufacturing manager

(Owned by Jefferson Smurfit Corp. [31%] and by SPB Canada Inc.)

Production facilities:

GROVETON, N.H.
Paperboard—300 tpd semichemical corrugating medium

Halifax Paper Board Co. Inc.
Roanoke Ave., Box 368
Roanoke Rapids, N.C. 27870-0368
Horace B. Faber Jr., chief executive officer

Production facilities:

ROANOKE RAPIDS, N.C.
Paperboard—85 tpd chipboard, laminating, newsboard, lined board

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Halltown Paperboard Co.
Box 110
Halltown, W.Va. 25423
C.C. Hammann, president

Production facilities:

HALLTOWN, W.VA.
Paperboard—200 tpd chipboard

Hennepin Paper Co.
(Sub. of Carlyle Investment Corp.)
100 S.W. 5th Ave.
Little Falls, Minn. 56345
Robert Strasburg, vice president/general manager

Production facilities:

LITTLE FALLS, MINN.
Pulp—80 tpd stone groundwood
Paper—80 tpd groundwood printings

Henry Molded Products Inc.
71 N. 16th St., Box 75
Lebanon, Pa. 17042
Douglass C. Henry, president/treasurer

Production facilities:

LEBANON, PA
Molded pulp products—15 tpd

Hercules Inc.
Box 271
Hopewell, Va. 23860
R.A. Marks Jr., plant manager

Production facilities:

HOPEWELL, VA
Pulp—240 tpd bleached chemical cotton linters (for market). To be shut down in 1988

Hollingsworth & Vose Co.
112 Washington St.
East Walpole, Mass. 02032
Gordon W. Moran, president/chief executive officer

Production facilities:

EAST WALPOLE, MASS.
Paper—45 tpd gasket, electrical insulating, packing, pattern, specialties

WEST GROTON, MASS.
Paper—50 tpd special industrial

GREENWICH, N.Y.
(Blandy Paper Div.)
Paper—15 tpd filter, impregnating

GREENWICH, N.Y.
(Easton Mill)
Paper—35 tpd filter, impregnating

Total production capacity:

Paper 145 tpd

Howard Paper Mills Inc.
115 Columbia St.
Dayton, Ohio 45407
Lou N. Mehr, president/general manager

Production facilities:

DAYTON, OHIO
Paper—125 tpd fine papers, business forms, copy, specialties

URBANA, OHIO
Paper—80 tpd fine papers, bond, business form, copy, specialties

Total production capacity:

Paper 205 tpd

Imperial Mfg. Co.
(Sub. of Wickes Cos. Inc.)
23645 Mercantile Rd.
Cleveland, Ohio 44122
William D. Armstrong, president, C&A Wallcoverings Inc.

Production facilities:

PLATTSBURGH, N.Y.
Paper—40 tpd hanging stock, tapestry, screen printing

Inland Empire Paper Co.
3320 N. Argonne
Spokane, Wash. 99212
Clyde B. Anderson, president

Production facilities:

MILLWOOD, WASH.
Pulp—200 tpd refiner mechanical, chemimechanical
Paper—200 tpd newsprint

Ivex Corp.
(Mill Div.)
292 Logan Ave.
Joliet, Ill. 60433
L.G. Holzbach, president/general manager

(Ivex bought Petratex Paper Co. in 1988.)

Production facilities:

JOLIET, ILL.
(Formerly Prairie State Paper Mills)
Paperboard—150 tpd car liner, mill wrappers, chipboard, tube stock

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Jackson Paper Manufacturing Inc.
(Sub. of Dixie Container Corp.)
Box 667
Sylva, N.C. 28779
Joseph B. Hinkie, mill manager

Production facilities:

SYLVA, N.C.
Paperboard—200 tpd recycled linerboard, corrugating medium

Keiding Inc.
4545 W. Woolworth Ave.
Milwaukee, Wis. 53218
Donald C. Bohlmann, president

Production facilities:

MILWAUKEE, WIS.
Molded pulp products

Kenaf International Inc.
McAllen, Texas 78502
Jerry Stanners, chairman/chief executive officer

(Early in 1988, Kenaf International and CIP Inc. decided their joint venture to make newsprint from kenaf pulp warranted continuation. They began acquiring land for a mill, fiber storage, and cogeneration, and they started looking for equity partners. In 1987, kenaf-based pulp was sent to CIP, which produced newsprint that was later used by newspaper publishers in California and Florida. The pulp mill would be sited near Brownsville, Texas.)

Kerwin Paper Co.
(Sub. of Amricon Corp.)
800 S. Lawe St.
Appleton, Wis. 54911
James A. Laurino, president

Production facilities:

APPLETON, WIS.
Pulp—70 tpd deinking
Paper—120 tpd bond, duplicator, writing, wedding bristols, cover, vellum

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Keyes Fibre Co.
(Div. of Royal Packaging Industries Van Leer B.V., Netherlands)
Two Stamford Square, 3003 Summer St.
Stamford, Conn. 06905
M. Walker Rast, president/chief executive officer

Production facilities:

ALBERTVILLE, ALA.
Molded pulp plate

SACRAMENTO, CALIF.
Molded pulp products—124 tpd

HAMMOND, IND.
Molded pulp products

SHAWMUT, MAINE
Pulp—120 tpd groundwood

WATERVILLE, MAINE
Molded pulp products

WENATCHEE, WASH.
Molded pulp products—30 tpd

Kieffer Paper Mills Inc.
1220 W. Spring St.
Brownstown, Ind. 47220
Kieran M. Devery, president

Production facilities:

BROWNSTOWN, IND.
Paper and board—130 tpd recycled corrugating medium, impregnating, industrial, specialty, wadding, wrapping

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Laurel Hill Paper Co.
Box 159
Cordova, N.C. 28330
J.T. Szewczak, chief executive officer

Production facilities:

CORDOVA, N.C.
Pulp—deinked
Paper—50 tpd tissue, toweling, specialty

Lincoln Paper Co.
300 Bergen Turnpike
Ridgefield Park, N.J. 07660

Production facilities:

RIDGEFIELD PARK, N.J.
Paperboard—175 tpd

Lincoln Pulp & Paper Co. Inc.
(Sub. of Preco Corp.)
Lincoln, Maine 04457

Production facilities:

LINCOLN, MAINE
Pulp—350 tpd bleached kraft (some for market)
Paper—165 tpd fine, 95 tpd tissue

Linweave Fine Papers Inc.
10 Linweave Dr.
Holyoke, Mass. 01040
Robert Belsky, president

Production facilities:

HOLYOKE, MASS.
Paper—65 tpd fine papers, bristols, greeting card, offset, papeterie, writing

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Little Rapids Corp.
2273 Larsen Rd., Box 19100
Green Bay, Wis. 54307-9100
Richard D. Egan, president

Production facilities:

POTSDAM, N.Y.
(Potsdam Paper Mills)
Paper—135 tpd fine, book, business form, offset, specialty; 50 tpd tissue

SHAWANO, WIS.
(Shawano Paper Mills)
Paper—160 tpd tissue, kraft converting, filter, saturating

Total production capacity:

Paper	345 tpd

Los Angeles Paper Box & Board Mills
5959 E. Randolph St.
Los Angeles, Calif. 90040
T.W. Holtz, mill manager

Production facilities:

LOS ANGELES, CALIF.
Paperboard—100 tpd boxboard

Lydall Inc.
(Fiber materials unit)
1 Colonial Road, Box 151
Manchester, Conn. 06040
David W. Clark Jr., president

Production facilities:

MANCHESTER, CONN.
(Lydall & Foulds Div.)
Paperboard—90 tpd chipboard, newsboard, anti-tarnish, specialty

ROCHESTER, N.H.
(Technical Papers Div.)
Paper—10 tpd filter, absorbent, insulating, specialty

GREEN ISLAND, N.Y.
(Manning Div., formerly Hammermill Paper Co.'s Manning Paper Co.)
Paperboard—30 tpd electrical insulating, filter, impregnating

HOOSICK FALLS, N.Y.
(Composite Materials Div.)
Paperboard—30 tpd stereotype matrix, ceramic, friction

COVINGTON, TENN.
(Composite Materials Div.)
Paperboard—60 tpd shoeboard, trunkboard, specialty

Total production capacity:

Paper/board	220 tpd

Lyons Falls Pulp & Paper Inc.
(Sub. of Old Forge Pulp & Paper Inc., Sub. of Elcon Inc.)
Box 338
Lyons Falls, N.Y. 13368
Frederick A. Szmit, president

Production facilities:

LYONS FALLS, N.Y.
Pulp—120 tpd semichemical
Paper—210 tpd offset, specialty

MH Dielectrics Inc.
1 Mountain St.
Mount Holly Springs, Pa. 17065
Leroy Briam, president

Production facilities:

MOUNT HOLLY SPRINGS, PA.
(Former Kimberly-Clark Corp., Schweitzer Div., mill)
Paper—15 tpd condenser, dielectric

Madison Paper Corp.
Box 129
Madison, Maine 04950
Jack E. Chinn, president/chief executive officer

(Owned 60% by Myllykoski Oy of Finland, 40% by New York Times Co.)

Production facilities:

MADISON, MAINE
Pulp—280 tpd groundwood
Paper—600 tpd supercalendered

Makin Pulp & Paper Ltd.
1600 Sun Life Plaza, 140 4th Ave., S.W.
Calgary, Alta. T2P 3N3
E.A. Mahood, president/chief executive officer

Production facilities:

BRITTANIA BEACH, B.C.
(Under construction; startup 1989)
Pulp—chemi-thermomechanical
Paper—400 tpd coated, uncoated

Malette Kraft Pulp & Power Inc.
(Sub. of Waferboard Corp. Ltd.)
Box 310
Smooth Rock Falls, Ont. P0L 2B0
J.R. Liddell, mill manager

Production facilities:

SMOOTH ROCK FALLS, ONT.
(Former Abitibi-Price Inc. mill)
Pulp—357 metric tpd kraft (for market)

Manchester Board & Paper Co.
200 Arlene St.
Richmond, Va. 23231
Kenneth Aspinall, president

Production facilities:

RICHMOND, VA
Paperboard—105 tpd chipboard, boxboard, manila, setup and folding

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Manfor Ltd.
Box 1590
The Pas, Man R9A 1L4
S.E. Balmer, president

(Manfor, owned by the Manitoba government since 1973, was put up for sale in late 1987.)

Production facilities:

THE PAS, MAN
Pulp—400 metric tpd unbleached kraft (some for market)
Paper—400 metric tpd unbleached kraft

Manistique Papers Inc.
(Div. of Field Corp.)
Box 309
Manistique, Mich. 49854
Leif Christensen, vice president/general manager

Production facilities:

MANISTIQUE, MICH
Paper—360 tpd newsprint, groundwood printing and converting

Marcal Paper Mills Inc.
1 Market St
Elmwood Park, N.J. 07407
R.L. Marcalus, chairman/chief executive officer

Production facilities:

ELMWOOD PARK, N.J.
Pulp—275 tpd deinked
Paper—250 tpd tissue

Marlboro Paper Inc.
191 St. Henri St., Box 366
Drummondville, Que. J2B 6W3
Hugh Parenteau, secretary/treasurer

Production facilities:

DRUMMONDVILLE, QUE.
Paper—15 metric tpd toilet tissue

Martisco Paper Co. Inc.
4747 Route 174, Box 198
Marcellus, N.Y. 13108
Floyd J. Petosa, president

Production facilities:

MARCELLUS, N.Y.
Paperboard—15 tpd bogus

McIntyre Paper Co. Inc.
131 Mill St
Fayetteville, N.Y. 13066
Fernand D. Fournier, president

Production facilities:

FAYETTEVILLE, N.Y.
Paper—15 tpd kraft anti-tarnish, wrapping, interleaving

NORFOLK, N.Y.
(Norfolk Paper Co. Inc., formerly Chagrin Fibers Inc.)
Paper—40 tpd masking, anti-tarnish, bags, converting

Total production capacity:

Paper	55 tpd

Menasha Corp.
Box 367
Neenah, Wis. 54956
D.C. Shepard, president

Production facilities:

OTSEGO, MICH
Pulp—300 tpd semichemical
Paperboard—500 tpd corrugating medium

Menominee Paper Co. Inc.
(Sub. of Bell Fibre Products Corp.)
144 First St
Menominee, Mich. 49858
Donald Estebo, general manager

Production facilities:

MENOMINEE, MICH
Paper/board—360 tpd lightweight machine glazed, linerboard, corrugating medium, waxing tissue

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Merrimac Paper Co. Inc.
9 S. Canal St.
Lawrence, Mass. 01843
John E. Thompson Jr., president/chief operating officer

Production facilities:

LAWRENCE, MASS.
Paper—90 tpd kraft specialty, bristols, cover, creping, insulating, technical

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Michigan Paperboard Corp.
(Sub. of Field Container Corp.)
79 E. Fountain St
Battle Creek, Mich. 49016
Terry Tiffany, general manager

Production facilities:

BATTLE CREEK, MICH
Paperboard—320 tpd recycled

Middleton Packaging Inc.
18752 San Jose Ave
City of Industry, Calif. 91748
John Jennett, president

Production facilities:

CITY OF INDUSTRY, CALIF.
Molded pulp products—15 tpd

Mi Ho Paper Co.
St. Joseph, Mo.
Hwa-Jin Yu, Korean paper mill owner

(Financing for a $52- to $55-million recycled paper mill, a venture of Rep. Korea businessman Hwa-Jin Yu and the St. Joseph, Mo., Chamber of Commerce, was being explored in spring 1988, and a site had been chosen.)

Production facilities:

ST. JOSEPH, MO
Recycled paper/paperboard

Millar Western Pulp Ltd.
(Sub. of Millar Western Industries Ltd.)
Box 60
Whitecourt, Alta. T0E 2L0
McKenzie Millar, president/chief executive officer

(Greenfield mill under construction; startup scheduled for second-half 1988.)

Production facilities:

WHITECOURT, ALTA.
Pulp—590 metric tpd bleached chemi-thermomechanical

Millen Industries Inc.
444 Park Ave. South
New York, N.Y. 10016-7368
Steven A. Schulman, president

Production facilities:

GARWOOD, N.J.
(Garwood Paperboard Mill)
Paperboard—115 tpd chipboard

Minas Basin Pulp & Power Co. Ltd.
Prince St.
Hantsport, N.S. B0P 1P0
J.J. Jodrey, chairman/chief executive officer

Production facilities:

HANTSPORT, N.S.
Pulp—40 metric tpd groundwood
Paperboard—120 metric tpd chipboard, linerboard, corrugating medium, mill wrappers, screenings

HANTSPORT, N.S.
(CKF Inc.)
Molded pulp products

Mohawk Paper Mills Inc.
465 Saratoga St.
Cohoes, N.Y. 12047
Thomas D. O'Connor, chairman/chief executive officer

(In autumn 1987, Stora Kopparberg of Sweden purchased 40% of Mohawk, and Mohawk bought 40% of Stora's Newton Falls Paper Mill Inc. Implementing a plan made prior to the exchange of stock, Mohawk will increase capacity to 80,000 or 90,000 tpy over five years.)

Production facilities:

COHOES, N.Y.
Paper—100 tpd text and offset, vellum, cover, specialty

WATERFORD, N.Y.
Paper—100 tpd coating base, cover, text, vellum, specialties

Total production capacity:

Paper	200 tpd

Monadnock Paper Mills Inc.
Antrim Rd.
Bennington, N.H. 03442
Richard G. Verney, chairman/chief executive officer

Production facilities:

BENNINGTON, N.H.
Paper—70 tpd art, book, cotton-fiber, industrial, technical specialty

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Monroe Paper Co.
(Jointly owned by Jefferson Smurfit Corp.)
1220 East Elm Ave.
Monroe, Mich. 48161
Robert J. Mitchell, chief operating officer

Production facilities:

MONROE, MICH.
Paper—250 tpd tube and core board, linerboard, industrial

Mosinee Paper Corp.
100 Main St.
Mosinee, Wis. 54455
Richard L. Radt, president/chief executive officer

Production facilities:

MIDDLETOWN, OHIO
(Sorg Paper Co.)
Pulp—100 tpd deinked
Paper—320 tpd bond, bible, card, writing, wrapping, specialty, tissue

MOSINEE, WIS.
(Pulp & Paper Div.)
Pulp—220 tpd semibleached kraft
Paper—265 tpd kraft toweling, insulating, waxing, technical specialty

Total production capacity:

Pulp	320 tpd
Paper	585 tpd

NVF Co.
Yorklyn Road
Yorklyn, Del. 19736
Victor Posner, chairman/president

Production facilities:

NEWARK, DEL.
(Primary Products Div.)
(Mill idle)
Paper—17 tpd basestock for vulcanized fiber

YORKLYN, DEL.
(Primary Products Div., Marshall Bros. Mill)
Paper—18 tpd basestock for vulcanized fiber

YORKLYN, DEL.
(Primary Products Div., No. 2 mill)
Pulp—20 tpd rags
Paper—20 tpd basestock for vulcanized fiber

HOLYOKE, MASS.
(Parsons Paper Div.)
Paper—25 tpd art, cotton-content bond, bristol, banknote, papeterie, technical specialty

Total production capacity:

Pulp	20 tpd
Paper	80 tpd

Newman & Co. Inc.
6101 Tacony St.
Philadelphia, Pa. 19135
Milton Newman, president

Production facilities:

PHILADELPHIA, PA.
Paperboard—195 tpd manila, chipboard, boxboard, newsboard, specialty board

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Newsprint South Inc.
(Sub. of Mississippi Chemical Corp.)
Box 849
Grenada, Miss. 38901
Tom Parry, president

(Groundwork began in fall 1987 for a $300-million, 224,000-tpy greenfield newsprint mill for late-1989 startup.)

Production facilities:

GRENADA, MISS.
Newsprint—630 tpd

Nicolet Inc.
Ford & Washington Sts.
Norristown, Pa. 19200
Rochelle Hittinger

(In July 1987, the company filed for reorganization under bankruptcy law.)

Production facilities:

NORRISTOWN, PA.
(Mill idle)
Paper—150 tpd specialty

Nolichucky Industries Corp.
Box 683
Greeneville, Tenn. 37744-0683
Tom Parker, executive director

NIC was formed in 1985 by former employees of Black Clawson Industries Inc. In fall 1987, the company announced plans to purchase from National Gypsum Co. a gypsum linerboard mill that had been closed for four years. The facility was converted to produce recycled linerboard and began shipping in spring 1988.

NIC also bought the Productos Forestales Caribe Inc. mill in Puerto Rico. The mill has capacity for about 225 tpd of corrugating medium and linerboard. Local wastepaper will be used for furnish. International Paper Co. built the mill in 1956 to produce industrial grades from bagasse.

In spring 1988, Nolichucky signed a lease arrangement (with option to purchase later) with James River Corp. to operate the latter's Hyde Park, Mass., mill, which was shut down at the end of 1987. A mid-summer restart was scheduled for the mill, which will eventually produce 55,000 tpy of recycled corrugating medium.

Production facilities:

KALAMAZOO, MICH.
Recycled linerboard—160 tpd

Ohio Pulp Mills Inc.
(Affiliate of Donco Paper Supply Co., Poly Recyclers Inc., and Ramblin Corp.)
2100 Losantiville Rd.
Cincinnati, Ohio 45237
Robert Mendelson, president

Production facilities:

CINCINNATI, OHIO
Pulp—30 tpd repulped board stock (for market)

Pabco Paper Products
(Sub. of Pacific Coast Building Products)
4460 Pacific Blvd.
Vernon, Calif. 90058
David J. Lucchetti, president

Production facilities:

VERNON, CALIF.
Paperboard—gypsum linerboard

Pacific Coast Packaging Corp.
4444 Pacific Blvd.
Vernon, Calif. 90058

Production facilities:

VERNON, CALIF.
(Mill idle)
Paperboard—130 tpd containerboard, boxboard, specialty

Paper Service Mills Inc.
Hinsdale, N.H. 03451
R.E. O'Neal, president/treasurer

Production facilities:

HINSDALE, N.H.
Paper—[illegible] tpd napkin, toilet, interleaving, packing tissue

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Paper-Pak Products Inc.
1941 White Ave.
La Verne, Calif. 91750
W.G. Hopkins, president

Production facilities:

LA VERNE, CALIF.
Cellulose wadding—55 tpd

Papertech Corp.
(Sub. of Conitex [USA] Inc.)
Rte. 127
West Hopkinton, N.H. 03229

Production facilities:

WEST HOPKINTON, N.H.
(Former Hoague-Sprague Corp. mill)
Paperboard—80 tpd chipboard, newsboard, tube stock

Penacook Fibre Co.
12 N. Main
Penacook, N.H. 03301
Richard S. Allen, president

Production facilities:

PENACOOK, N.H.
Paperboard—10 tpd shoeboard, trunkboard, wet machine board

Penntech Papers Inc.
3 Barker Ave.
White Plains, N.Y. 10601
John Leslie, chairman/president

Production facilities:

JOHNSONBURG, PA.
Pulp—220 tpd bleached kraft
Paper—380 tpd printing/publication, bond, computer, envelope

Perkins Papers Ltd.
2345 Autoroute des Laurentides
Laval, Que. H7S 1Z7
Everett A. Boyle, president/chief executive officer

Production facilities:

CANDIAC, QUE.
Pulp—100 tpd deinking
Paper—100 tpd tissue

Perkit Folding Box Corp.
36 Poydras St.
Mattapan, Mass. 02126
Sheldon Appel, president

Production facilities:

MATTAPAN, MASS.
Paper—75 tpd boxboard, chipboard, folding boxboard

Petratex Paper Co. Inc.
(Sub. of Ivex Corp.)
Box 1820
Peoria, Ill. 61656
Virgil Perry, president

Production facilities:

PEORIA, ILL.
(Former Bemis Co. Inc. mill)
Paper—65 tpd crepe, coated flour and multiwall bag, kraft specialties

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Ponderosa Fibres of America
1100 Circle 75 Parkway, Suite 260
Atlanta, Ga. 30339
Edward Sokolowsky, vice president-administration

Production facilities:

SANTA ANA, CALIF.
(B.J. Fibres Inc.)
Pulp—100 tpd deinking (for market)

AUGUSTA, GA.
(Ponderosa Georgia Corp.)
Pulp—120 tpd deinking (for market)

MEMPHIS, TENN.
(Ponderosa of Tennessee Corp.)
Pulp—100 tpd deinking (for market)

OSHKOSH, WIS.
(Ponderosa Pulp Products Corp.)
Pulp—150 tpd deinking (for market)

Total production capacity:

Pulp	470 tpd

V. Ponte & Sons Inc.
1 Ackerman Ave.
Clifton, N.J. 07011

(Mill was closed in 1980 when owner Whippany Paper Board Co. declared bankruptcy. Purchased by wastepaper dealer Ponte early in 1988 on second attempt, the mill will require some $5 million to restore it for operation.)

Production facilities:

CLIFTON, N.J.
(Mill idle)
Recycled paperboard—350 tpd

Portals Inc.
(Sub. of Portals Ltd., U.K.)
Box 267
Hawkinsville, Ga.

(Mill up for sale.)

Production facilities:

HAWKINSVILLE, GA
(Mill idle)
Paper—10 tpd currency, security

Port Townsend Paper Corp.
(Div. of Haindl Papier GmbH, Fed. Rep. Germany)
Box 3170
Port Townsend, Wash. 98368
Juan del Valle, president

Production facilities:

PORT TOWNSEND, WASH
Pulp—450 tpd unbleached kraft softwood (140 tpd for market)
Paper—450 tpd linerboard, kraft packaging, bag, wrapping

Quaker Oats Co.
(Paper Div.)
Box 520
Pekin, Ill. 61555-0520
Warren Feerer, plant manager

Production facilities:

PEKIN, ILL
Paperboard—85 tpd boxboard, chipboard, food board, tube

Quin-T Corp. New Hampshire
Box 309
Tilton, N.H. 03276
F.L. Wardley, president

Production facilities:

TILTON, N.H.
Paper/board—saturating, specialty

Quin-T Corp.-Pennsylvania
(Technical Papers & Boards Div.)
140 E. 16th St.
Erie, Pa. 16512
R.W. McNamara, vice president, marketing

Production facilities:

ERIE, PA
Paper/board—100 tpd gasketing, special industrial

Rand Whitney Paperboard Corp.
(Formerly Robertson Paper Box Co. Inc.)
Rte. 163
Montville, Conn. 06353
Donald Maher, operations manager

Production facilities:

MONTVILLE, CONN
Paperboard—65 tpd boxboard, chipboard, specialty board

Reading/White Hall Paper Board Co. Inc.
(Sub. of Maryland Paper Box Co.)
Box 8
White Hall, Md. 21161

Production facilities:

WHITE HALL, MD
(Mill idle)
Paperboard—40 tpd boxboard, manila board, patent coated board

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Red Hook Paper Corp.
Spring Lake Rd., Box 133
Red Hook, N.Y. 12571
Barry Hull, president

Production facilities:

RED HOOK, N.Y.
Paperboard—15 tpd plain chipboard, bogus wrapping

Republic Paperboard Co.
(Sub. of Republic Gypsum Co.)
3625 Miller Park Dr.
Garland, Texas 75040
Paul R. Brown, president

Production facilities:

COMMERCE CITY, COLO
Recycled board—145 tpd

HUTCHISON, KAN
Recycled board—250 tpd

Total production capacity:

Paperboard 395 tpd

Rising Paper Co.
Park St.
Housatonic, Mass. 01236
Robert E. O'Connor, president

(Company acquired by Fox River Paper Co. in spring 1988.)

Production facilities:

HOUSATONIC, MASS
Pulp—50 tpd rag, sulfite
Paper—60 tpd fine papers, art, bond, bristols, papeterie, technical, specialties

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G.E. Robertson & Co.
Canal St.
Hinsdale, N.H. 03451
Leo J. Gratton, president

Production facilities:

HINSDALE, N.H.
Paper—8 tpd tissue

Rolland Inc.
2000 McGill College Ave., 14th Floor
Montreal, Que. H3A 3H3
Lucien G. Rolland, chairman/chief executive officer

(In 1986, Rolland agreed to market the output of Fitchburg Paper Co., with an option to buy the mill. In mid-1987, Rolland bought two of the three Fitchburg machines, with an option to obtain the third one. Also in 1987, Cascades Inc. made a takeover bid for Rolland, which the company rejected.)

Production facilities:

MONT-ROLLAND, QUE
Paper—40 metric tpd decorative paper for laminates, specialty papers

SAINT JEROME, QUE
Paper—325 metric tpd uncoated fine papers and specialties: all-cotton to chemical pulp grades for printing, business, envelopes

FITCHBURG, MASS
(Rolland Fitchburg Paper Inc.)
Paper—225 short tpd (200 metric) decorative paper for laminates

Total production capacity:

Paper 565 metric tpd

St. Marys Paper Inc.
75 Huron St.
Sault Ste. Marie, Ont. P6A 5P4
Don Alexander, president/chief executive officer

(Owned 25% by Rauma-Repola Oy, Finland.)

Capacity for 118,840 metric tpy supercalendered paper being added for November 1988 startup.

Production facilities:

SAULT STE. MARIE, ONT
Pulp—290 metric tpd stone groundwood
Paper—320 metric tpd supercalendered groundwood specialties

St. Raymond Paper (1983) Inc.
Box 609
St. Raymond, Que. G0A 4G0
Donald McDougall, owner/president

[The St. Raymond, Que., mill was leased from Imperial Trust by McDougall in spring 1987. The Desbiens, Que., mill entered into a joint venture with Johnson & Johnson Inc., under the name Desbiens Products Inc., to make health care products from spagnum moss. In the fall of 1987, St. Raymond acquired Mohawk Pulp Co. Ltd. (owned by McDougall). In December 1987, approval was given for St. Raymond to take over Pejepscot Paper Inc., which had filed for Chapter 11 protection under the bankruptcy code on May 1, 1987, following closure of the mill in March due to damage caused by flooding of the Androscoggin River. The mill was expected to restart early in 1988.]

Production facilities:

CHEMIN-du-LAC, QUE.
(Former Mohawk Pulp Co. Ltd. mill)
Pulp—50 metric tpd unbleached mechanical groundwood (for market)

RIVIERE-du-LOUP, QUE.
(Former Mohawk Pulp Co. Ltd. mill)
Pulp—40 metric tpd stone groundwood (for market)

ST. RAYMOND, QUE.
Pulp—130 metric tpd groundwood
Paper—145 metric tpd hanging, specialty, newsprint

BRUNSWICK, MAINE
(St. Raymond Corp., formerly Pejepscot Paper Co.)
Pulp—160 tpd (145 metric) thermomechanical
Paper—165 tpd (150 metric) fine; 95 tpd (66 metric) tissue

MECHANIC FALLS, MAINE
(Falls Tissue Inc.; former Marcal Paper Mills Inc. mill, acquired by Pejepscot in 1986)
(Mill idle)
Paper—70 tpd (64 metric) tissue, toweling, wadding

Total production capacity:

Pulp	365 metric tpd
Paper	425 metric tpd

Schoeller Technical Papers Inc.
(Sub. of Felix Schoeller Jr. GmbH, Fed. Rep. Germany)
Centerville Rd.
Pulaski, N.Y. 13142
R.O. Gall, president/general manager

Production facilities:

PULASKI, N.Y.
Paper—100 tpd photographic and industrial recording/reproducing, custom technical specialty

Seaman Paper Co. of Massachusetts Inc.
Main St., Box 21
Otter River, Mass. 01436
George Jones III, president

Production facilities:

OTTER RIVER, MASS.
Paper—75 tpd carbonizing, printing, groundwood specialties

Shryock Bros. Inc.
Box 157
Downingtown, Pa. 19335
Robert M. McIlvain, president

Production facilities:

DOWNINGTOWN, PA.
Paper and board—26 tpd binders board, specialty paper

Sierra Tissue Co. Inc.
560 E. Commercial St.
Pomona, Calif. 91766
Walter A. Richter, president

Production facilities:

POMONA, CALIF.
Paper—14 tpd tissue

Simkins Industries Inc.
259 East St.
New Haven, Conn. 06508
Leon J. Simkins, president

Production facilities:

NEW HAVEN, CONN.
(New Haven Board Div.)
Paperboard—220 tpd coated

MIAMI, FLA.
(Miami Board Div.)
(Mill idle)
Paperboard—100 tpd boxboard, lined board, specialty

AUGUSTA (Nixon), GA.
(Former Deerfield Specialty Papers mill)
Paper—55 tpd glassine, greaseproof

INDIANAPOLIS, IND.
(Beveridge Paper Co. Inc.)
Paperboard—60 tpd bristols, mill boards, cover, embossing, laminating, specialty

CATONSVILLE (Ilchester), MD.
(Maryland Board Div.)
Paperboard—170 tpd boxboard, chipboard, patent coated, newsboard

LEE, MASS.
(Westfield River Paper Co. Inc.)
Paper—15 tpd glassine specialty

MONROE BRIDGE, MASS.
(Mill closed permanently)
Paper—45 tpd glassine, greaseproof, laminating, waxing)

RUSSELL, MASS.
(Westfield River Paper Co. Inc.)
Paper—50 tpd glassine, specialty

RIDGEFIELD, N.J.
(Lowe Paper Co.)
Paperboard—140 tpd boxboard, laminating, postcard, tag, specialty

QUEBEC CITY, QUE.
(Glassine Canada Inc.)
Paper—33 metric tpd (36 short) glassine, greaseproof, laminating, oil resistant, specialty

Total production capacity:

Paper	201 tpd
Paperboard	690 tpd
Total	891 tpd

Simplex Products
(Div. of Anthony Industries Inc.)
3000 W. Beecher St.
Adrian, Mich. 49221
Robert E. Doyle, president

Production facilities:

CONSTANTINE, MICH.
Paperboard—100 tpd chipboard

Simplicity Pattern Co. Inc.
901 Wayne St.
Niles, Mich. 49121
C. DeWitt, plant manager

Production facilities:

NILES, MICH.
Paper—35 tpd pattern tissue

Southern Cellulose Products Inc.
105 W. 45th St., Box 2278
Chattanooga, Tenn. 37409
Orville M. McClure, president

Production facilities:

CHATTANOOGA, TENN.
Pulp—90 tpd cotton linters (for market)

Southworth Co.
Front St
West Springfield, Mass 01089
John H. Southworth, president

Production facilities:

WEST SPRINGFIELD, MASS.
Paper—20 tpd fine papers, bond, cotton fiber, linen finish, onion skin, rag

Spaulding Fibre Co. Inc.
310 Wheeler St
Tonawanda, N.Y. 14150
G. Marton, president

(In late December 1987, the North Rochester, N.H., mill was closed down and put up for sale.)

Production facilities:

NORTH ROCHESTER, N.H.
(Technical Paper & Board Div.)
(Mill idle)
Paperboard—50 tpd transformer board, electrical insulation board

TONAWANDA, N.Y.
(Industrial Plastics Div.)
Pulp—15 tpd rag
Paper—25 tpd vulcanizing, impregnating

Total production capacity:

Pulp	15 tpd
Paper	25 tpd
Paperboard	50 tpd

Specialty Paper Mills Inc.
Box 3188
Santa Fe Springs, Calif. 90670
J.A. Gabriel, president

Production facilities:

SANTA FE SPRINGS, CALIF.
Paperboard—75 tpd corrugating medium, chipboard, test linerboard

Statler Tissue Corp.
(Div. of Statler Industries Inc.)
300 Middlesex Ave.
Medford, Mass. 02155
Leonard Sugarman, president

Production facilities:

AUGUSTA, MAINE
Paper—150 tpd facial, napkin, toilet and toweling tissue

Stevens & Thompson Paper Co.
Box 206
Greenwich, N.Y. 12834
Emory L. Waldrip II, president

Production facilities:

MIDDLE FALLS, N.Y.
Paper—60 tpd facial, toilet, toweling tissue

Strathcona Paper Co.
(Div. of Roman Corp. Ltd.)
Box 136
Napanee, Ont. K7R 3L6
W.E. Riddolls, president

Production facilities:

NEPANEE, ONT.
Paperboard—160 metric tpd boxboard, chipboard, newsboard

Tagsons Papers Inc.
Mechanicville, N.Y. 12118
Eugene J. Galante, president/treasurer

(Tagsons rebuilt its tissue machine in 1987-88, enabling production of heavier-weight grades and higher speeds, and it installed new converting equipment.)

Production facilities:

MECHANICVILLE, N.Y.
Paper—150 tpd toweling, creping, tissue, embossing, interleaving

Tembec Inc.
800 Dorchester Blvd. W., Suite 2790
Montreal, Que. H3B 1X9, Canada
F.A. Dottori, president/chief executive officer

(Installation of a 110,000-metric-tpy bleached board machine was approved in mid-1987. In spring 1988, a 140,000-tpy machine was ordered for startup in late 1989. Dissolving and sulfite-paper pulp lines will be expanded by about 20,000 tpy, and the Temcell bleached chemi-thermomechanical mill will be expanded by about 35,000 tpy. A second CTMP line may be considered.)

Production facilities:

TEMISCAMING, QUE.
Pulp—550 metric tpd sulfite specialty; 250 tpd bleached chemi-thermomechanical (for market)

Texcrom Paper Corp.
600 Paper Mill Rd.
Chambersburg, Pa. 17201
Paul T. Gallagher, president

(United States Paper Mills Inc. mill purchased by two former Crown Zellerbach Corp. officials—one of them Gallagher—and a third party. One machine was restarted in 1986, and the second one was due to start in 1987. However, the mill was idled in February 1987 while the company reorganized.)

Production facilities:

CHAMBERSBURG, PA.
(Mill idle)
Paper—15 tpd towels

Texon Inc.
(Div. of Emhart Corp.)
Canal St.
South Hadley, Mass. 01075
A. Peter Clackson, president, Emhart Footwear Materials Group

Production facilities:

RUSSELL, MASS.
Paper and board—elastomeric fiber innersole and fiber base, gasket, hat and cap materials

SOUTH HADLEY, MASS.
(Mill idle)
Paper and board—elastomeric fiber and resin saturated base material

3M Co.
(Carbonless Products Dept.)
3M Center
St. Paul, Minn. 55144
James A. Thompson, department manager

Production facilities:

NEKOOSA, WIS.
Paper—carbonless

Tomahawk Power & Pulp Co.
(Sub. of Hardwoods Corp. of America)
N10099 Kings Road
Tomahawk, Wis. 54487
John J. Laughlin, president

Production facilities:

TOMAHAWK, WIS.
Pulp—50 tpd groundwood (for market)

Tomahawk Tissue Corp.
(Div. of Tomahawk Power & Pulp Co.)
Box 266
Tomahawk, Wis. 54487
Marvin L. Sievert, vice president/general manager

Production facilities:

TOMAHAWK, WIS.
Pulp—deinked
Paper—25 tpd tissue, toweling

Toronto Paperboard Co.
Loretta Ave.
Toronto, Ohio 43964
C.A. Dufon, president

(Owners of the company declared bankruptcy in 1988 and planned to liquidate assets.)

Production facilities:

TORONTO, OHIO
(Mill idle)
Paperboard—135 tpd boxboard, chipboard, containerboard, core stock, lined board, tube stock, specialties

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U.S. Packaging Inc.
Box 415
Maxton, N.C. 28364
Mark Speckman, president

Production facilities:

MAXTON, N.C.
(Former Leggett & Platt Inc. mill)
Cellulose wadding—12 tpd

U.S. Paper Mills Corp.
824 Ft. Howard Ave., Box 3309
De Pere, Wis. 54115
Walter R. Cloud, chairman/chief executive officer

Production facilities:

DE PERE, WIS.
Recycled paperboard—100 tpd core stock, chipboard

MENASHA, WIS.
(Menasha Div.)
Paperboard—150 tpd chipboard, boxboard, test linerboard, mill wrappers

Total production capacity:

Paperboard 250 tpd

Valentine Pulp & Paper Co.
(Div. of Technographics Inc.)
Box 280
Lockport, La. 70394
Thomas D. Robichaux, vice president

Production facilities:

LOCKPORT, LA.
Paper—140 tpd fine, specialty

Vermont Tissue Paper Corp.
Rte. 67-A
North Bennington, Vt. 05257
Edward Woodard, president

Production facilities:

NORTH BENNINGTON, VT.
Paper—10 tpd standard, stuffing and bogus tissue

Watervliet Paper Co. Inc.
(Sub. of Shoreham Packaging Group Inc.)
279 Paw Paw Ave.
Watervliet, Mich. 49098
David D. Stiles, chairman/president

Production facilities:

WATERVLIET, MICH.
Paper—145 tpd coated, label, cover, playing card, rotogravure

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Weston Paper & Mfg. Co.
2001 N. 19th St., Box 238
Terre Haute, Ind. 47808
Edward T. Turner Jr., chairman/president

Production facilities:

TERRE HAUTE, IND.
Pulp—300 tpd semichemical
Paperboard—425 tpd corrugating medium

Westbrook Wood Products
Smith River, Calif. 95567
Hank Westbrook, president

(Proposed $300-million integrated thermomechanical/publication papers mill in northern California or southern Oregon, possibly with Japanese and U.S. publishers as investors.)

White Pigeon Paper Co.
Box 277
White Pigeon, Mich. 49099
James V. Lamarre, president

Production facilities:

WHITE PIGEON, MISS.
Paperboard—170 tpd boxboard, coated

George A. Whiting Paper Co.
100 River St.
Menasha, Wis. 54952
Frank B. Whiting, chairman/chief executive officer

Production facilities:

MENASHA, WIS.
Paper—25 tpd art paper, fine papers, papeterie, specialties

Windsor Stevens Inc.
Stevens Mill Rd.
Windsor, Conn. 06095
Milton Gordon, president

Production facilities:

WINDSOR, CONN.
Paperboard—10 tpd electrical insulation

Woodstream Corp.
Front & Locust Sts.
Lititz, Pa. 17543
R.G. Woolworth, chairman/chief executive officer

Production facilities:

LITITZ, PA.
Molded pulp products—9 tpd

Yorktowne Paper Mills Inc.
Loucks Mill Rd.
York, Pa. 17405
Daniel J. Sparler, chairman/chief executive officer

Production facilities:

GARDINER, MAINE
(Yorktowne Paper Mills of Maine Inc.)
Paper and board—80 tpd chipboard, car and case lining, cores, specialties

YORK, PA.
Paperboard—100 tpd boxboard, chipboard, can and core stock, cores

Total production capacity:

Paperboard 180 tpd